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DIGIPIX 3

COMPENDIUM FOR DIGITAL PHOTOGRAPHY

A cooperation of :

arbeitskreis adf: digitale fotografie

European Color Initiative
www.eci.org

English translation sponsored by:

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Dear readers.

The "Compendium for digital photography" aka. "DigiPix" in version 3 was originally written and published November 2004 in and by the cooperation of the adf (Working Group Digital Photography) and the ECI (European Color Initiative) - in german only. With the kind of positive acceptance we received in public the idea of an international version available in english was soon born and eventually realized. Due to the fast paced innovation in the field of digital photography and digital imaging in general some areas of this guide are not up-to-date with the latest and greatest. An updated version will be available in the near future.
Meanwhile the authoring team hopes to provide you, the photographer with a batch of tips and helpful background info, in order to make your daily digital job a lot easier.

I would like to thank the sponsors, Image Engineering Dietmar Wüller, Tecco Braun & Frings GmbH and LaserSoft Imaging AG for making this translation possible through their much appreciated support.

We wanted to make sure that this publication can be used as freely as possible which is why we issued CREATIVE COMMONS PUBLIC LICENSE at the end of this document. We the authors expect the compliance with it.

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September of 2006

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1. Color management

1.1 Basics Color management

The overlapping communication of color according to ICC-Standard is todays foundation for color management in a media production environment. Applied color management will bring predictability and consequently security along into the color workflow, from data input to conversion and output processing.

What is the fundamental challenge of color management within the boundaries of physics:
- make the scan look like the original on the monitor
- make the print look like the original on the monitor
- make the print of a scan, without much examination on the monitor, look very similar to the original
- generate verification for images to look similar on different machines and monitors

Ten years after its introduction the vendor and platform independent ICC-Standard has reached a high professional level and creates the basis for an efficient color management system, in combination with a progressive hard- and software development.
The entire communication of color in a modern production environment is going through a stage of modification, which yet already takes place during photography due to the increased commitment to digital photography. Whenever precise color reproduction is mandatory – especially when shooting in a studio – color management can be applied in digital photography as such. When shooting outdoors the vendors color transformations inside the camera will seize, for the user color management starts once the final image will be displayed on the monitor.

Working environment, general set-up

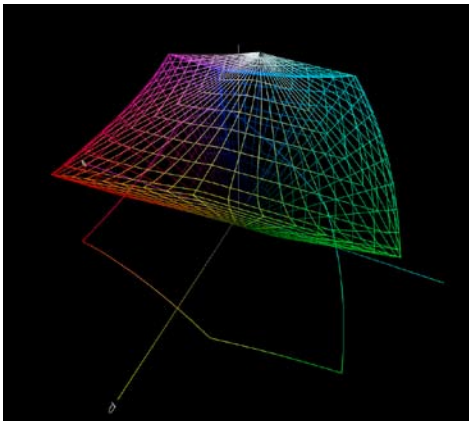
ICC Profiles which characterize the color reproduction of a certain device are being used in a controllable and safe process with image data in order to transport color in a production process. The ICC specifies device profiles (ICC profiles) and the mapping of the color engine used, which realizes a consequent color management from photography to print respectively displaying the images on the monitor.
The actual photography is very often the source for color data, hence in the beginning there is the digitalization of a subject respectively a scene or a scan. A modern working environment is based on the

digital capture and reproduction of originals with a device or software which supports color management and implements itself into the workflow harmoniously.

Basic principles of color management / Conversion with ICC profiles

Communication in a standardized language is crucial for any kind of management. Based on human color vision and comprehending all visual colors the device independent "CIE-L*a*b*" (see end of chapter) color model is used as a standardized language, which describes an equidistant color space based on human color reception. This is the basic principle of color management.

Any input- and output device participating in the production process (digital camera, scanner, monitor, printer, etc.) features an individual characteristic way of color reproduction and describes a portion of the colors which are visible for humans. This portion, which is being referred to as "device color space", is visualized three dimensionally as CIE-L*a*b* color space in the graphic below. In order to transport color in a standardized, comprehensive and unique way through the production process, ICC profiles of every single device have to be created. The ICC profile establishes the connection between the according device dependent characteristic (device specific RGB or CMYK) and the device independent characteristic CIE-L*a*b* - in other words: The individual color idioms of the individual input- and output devices are translated into a mutual language. Due to the fact that the profile captures only a certain amount of colors, an extra engine – the so called CMM (Color Management Module) – is necessary for the calculation of the secondary tonal values, one of each operation system, Apple and Microsoft, already has one built in.



Due to the mutual language within the ICC profiles it is now commonly defined, how certain devices see and reproduce certain color values. Therefore single colors as well as complete images can be processed and controlled as requested. For this purpose the ICC profiles, the CMM's and their implementation into the applications will merge together and result in a color management workflow, in cooperation

with the special retouching-, editing- and proofing functionality.

Basic principles for data management / Workflow with ICC profiles, Interfaces

From the photographers view as the "data originator" data processing and distribution in RGB is the better option, which one while retouching can fall back to softproof functionality – if desired or requested – in order to simulate the final output- or printed result. Needless to say the final output system needs to be familiar.

The input data is in relation to the complete workflow resembled as digital photographs or scans, which will eventually get edited and transferred either directly or afterwards in company with graphic- respectively text elements into a layout application like Quark Xpress or Adobe InDesign in order to be optimized and exported into the final output process.

The softproof-visualisation displays a preview of the printed output "on-the-fly".

The photographer will initiate the commission of data according to the status of an image either to the post-production or prepress interface.

The color- and process related optimization of data to the according output process (in a normal case the separation from RGB to CMYK))can occur at different sets of the workflow, while one generally needs to differentiate between the process independent and process dependent approach.

The output optimization (separation) needs to take place at the end when applying a medianeutral workflow and data management which itself will generate perfect premises for the optimization to further output processes. When choosing a process dependent approach the optimization respectively the commitment to specified output conditions will occur at an earlier stage in the workflow.

Both workflow options feature their advantages, with the possibility for an optional hybrid approach at a later time. To which extent the photographer will perform the output optimization needs to be decided upon individually and to the standard of knowledge. It shouldn't be regarded as the one primary exercise for the photographer.

The integration of ICC color management to a working environment supplies these possibilities. Color management can make access to generic or idealized color spaces or process descriptions like ECI-RGB, ISOcoated, PDF/X,..... or depend upon adaptions of special devices via individual ICC compatible procedures.

As one important component of workflow and data management, applied color management can safeguard adequate flexibility and security to the according interfaces, much as the transfer of image material of photographers to postproduction/prepress. It greatly matters to save the current description of color in the shape of an ICC profile to every image.

(*) CIE = Commission Internationale de l'Eclairage. Defined in 1931 the XYZ-color model and subsequently further standards, for example the familiar CIE-standard color chart, known as the sole. This definition is based upon results of the latest research, from which a "standard observer" was defined. This standard observer complies with 90% of the color reception of humans. In 1976 the CIE-Lab color space was introduced by the CIE, which in contrary to the "sole" had the advantage of the calculative offset similarity.

1.2 Profiling a digital camera

Advantages of camera profiles

The advantage in the application of individually created camera profiles lies within the compensation of "color-ametropia" (failure of visibility) of colors, which is inherent in any digital camera. The color-ametropia differs from vendor to vendor as will discrepancies occur between one vendors camera models. Through the use of camera profiles the photographer has more security, as a more precise color reproduction from one camera as well as many different cameras, instead of having to pass through long editing cycles in image editing applications. Ultimately the use of camera profiles reduces the hours of work per image and therefore increases productivity.

Camera profile, more than a digital emulsion

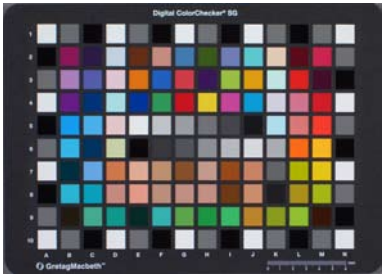
Through the application of camera profiles a digital camera is much more qualified for the precise reproduction of colors than the analogue film ever has been.
Just like the film emulsions in analogue photography were designed for different types of light it is essential for camera profiles to be optimized for one type of light and should be applied with this only. While in analogue photography the applied daylight- or tungsten light film in contrary to the used camera and optics displays the most important parameter for color reproduction, the used camera and processing technology and further workflow inside the camera plays a major role, i.e. inside the raw data converter for color reproduction, which has to be incorporated when creating a profile. Thus the camera profile describes the characteristic of a camera with certain light as well as the adjacent camera- and data processing. Furthermore not only daylight- or tungsten customizations can be realized via camera profiles, but as many "Illuminant-profiles" as needed for photographic work, i.e. a profile for HMI- or fluorescent tubes. The profile can be applied to similar light types again and again – just like daylight or tungsten film in analogue photography. For example a profile created for flash light in many cases can be applied on a daylight location, when using the white balance functionality inside the camera. This operation method will save the photographer a lot of effort instead of having to create a new profile for every new composition. Preferably the camera profile should only incorporate an exposure- or contrast adaptation, if necessary due to insufficient exposure or gradation when taking the photo. The correct exposure and choice of gradation will remain the photographer's responsibility, just like selective application of white balance. So mainly the camera profile is supposed to correct the color reproduction of a camera.

Range of application for camera profiles

This preliminary remark about the advantages of camera profiles already indicates the range of application of such camera profiles. The application of camera profiles plays a vital role whenever an exposure depends on exact color reproduction. This could be art reproductions, table-top and studio photography and whenever there is an increased demand in color reproduction, e.g. for a corporate-, logo- or product color. In photo journalism, where it is all about speed and changing recording condition, in artistic photography as well as generally when disposing a mood or feeling, color does represent a vital role, but the precision of color plays an rather inferior role. In these cases the use of individual camera profiles is not categorically mandatory and due to the customization of the workflow partly obstructive.

Creation of profiles

Software and adequate test charts:
When creating camera profiles special test charts are necessary besides the profiling software in order to capture the color characteristics of the camera.
In principle the best test chart for this purpose is dependent on the profiling software. The most commonly distributed test charts for profiling cameras are from Gretag Macbeth. For one thing the Digital ColorCheckerSG and the ColorCheckerDC as well as the ColorChecker with 24 color patches can be named here, whereas the ColorCheckerSG gathers the color characteristics of the camera best due to its material properties. Some profiling packages also use test charts produced on glossy photographic materials with additional greycards on differing materials and can create good results. IT8 test charts used for profiling scanners are unqualified for profiling cameras. It is important for the appropriate test charts to offer a good share of bright, semi bright and dark colors, no optical brighteners as well as feature highly saturated colors and therefore represent a large color space. On the other hand the colors are supposed to fill in the color space consistently and a neutral grey balance (no color cast under certain types of light) for determination of the grey balance, which will represent the grey characteristics of the camera. A duller patch will prevent glossy like reflections of light more likely whereas on the other hand the color characteristics of the camera with highly saturated colors can not be captured satisfactory. Hence a semi matte material is a good compromise.



The Color Checker SG from Gretag Macbeth

Profiling software should be able to operate according to most recent ICC specifications and use chromatic adaption after Bradford (mathematical function to adapt data to different light types) or newer methods. The software needs to support different types of light and if applicable add user-oriented types of light. Grey balance needs to be able to operate in two different settings: choose a grey balance which is calculated automatically from the software based on the data from the test chart or not to affect the grey balance setting in the camera.

In addition the camera profiling software needs to leave some options to the user, in order to customise the profile according to individual requirements. Just as different film types were used in analogue photography in order to achieve perfect skin tones for example, the profiling software should offer the opportunity to customise a camera profile in relation to the sole purpose of its use.

Capturing the test chart and exposure

The most successful way to create a camera profile is to shoot the test chart under repro illumination and preferably record with maximum bit depth. This means to place the light source – preferably two heads from left and right - in a 45° angle to the camera and to the test chart, in order to illuminate the chart as plane and evenly as possible. The ideal condition for capturing the test chart is a darkened room with no disturbing reflections on the chart as well as light source with constant temperature, illumination of light and equal brightness. Likewise the test chart can be captured outside the studio as well if disturbing refections and mirroring can be prevented. Reflections can be minimized by underlaying or hanging a matte black or grey piece of cardboard or cloth of adequate size.

The right exposure for the test chart is essential for the success of a premium digital camera profile. If the exposure of the test chart is darker than that of the images you will be taking, the profile will make the images look much brighter. In reverse a brighter exposure of the test chart will end in a darker reproduction of your images. The correct exposure should best be determined by a row of exposures. A reference value for the correct exposure when using the Gretag Macbeth test charts can be checked upon by the white test chart patches. The patch should keep lower RGB values than the white areas of your image with just as little detail as possible. When using premium studio cameras the right exposure of the test chart should result in RGB values from 235-245 in the white patches. For SLR and rangefinder cameras a good starting point for the right exposure of the test chart is measuring a greycard (e.g. the Kodak-

greycard) and transferring the exposure values to the test chart shot.

Since color-ametropia shows different effects with different lighting conditions, it would be self-evident to place the test chart directly into the scene to be photographed and create the profile from there. Practical experience shows little success for this approach. The illumination of the scene very often leads to e.g. black patches of the test chart to be too light as a result of direct reflections of a light source and therefore will create errors in the profile. The same is obviously true for the patches that reflect directly into the direction of the camera. Add occurring falsification of colors to this, due to reflections of colored objects in the scene. For example, when shooting a tabletop setup on a colored underground, the reflections of the underground will interfere and lead to falsified colors in the test chart and to bad profiles. Likewise with reflections of metal objects or white walls which can influence the capturing of the test chart in a negative way.

White balance

A correct white balance is one of the most essential requirements for a good profile as well as the subsequent application of the profile. The white balance can be comprehended as a calibration of the camera to the according lighting conditions. It must be pointed out that some SLRs and Rangefinder cameras will accomplish the white balance by a white area. If using an improper material like a piece of paper for this it may lead to drastic errors in the profile due to optical brighteners in many papers. An alternative for the correct white balance with a larger, neutral area is the use of the Gretag Macbeth White balance Card. The predominant portion of cameras will acquire white balance of a neutral grey area. There are full-format greycards available on the market for this. A Kodak greycard with its 18% reflection is very appropriate for exposure metering, but not for white balance, since it is not sufficiently neutral.

Depending on the camera the greycard needs to be captured full-frame. The grey patches of the camera chart can be utilized for white balance as well for more premium cameras. Double check the white balance in the image via the pipette of your image editing application or the raw data converter. A successful white balance will favour an interpretation of the camera of neutral grey areas in the image with equal RGB values.

If the white balance, the exposure and the illumination of the test chart have been performed according to these instructions, then you have made a foundation for a good camera profile. Please consider during the application of the camera profile that the profile will oper-

ate reliably just as long as the basic settings in the camera respectively in the further editing workflow are maintained between the image capturing and the capturing of the test chart. If e.g. switching the raw data converter, the profile created with a different converter can not be applied anymore. Furthermore, always keep in mind to double check white balance as an essential quality feature during image capture and modify it if necessary, then you are on the safe side, to use the one-time created camera profiles for a lot of shots.

1.3 Working spaces

In image editing applications the effect of certain tools on image data is influenced by the color mode used – one reason to look into color modes and color spaces a little closer.
It is an interesting experiment to perform the same adjustment of image contrast once in RGB, CMYK and Lab. When increasing the contrast of the image a little by lowering the shadows and raising the highlights you will be able to experience – dedicated image material presumed – the following effect:
RGB color mode: saturation of colors is increased.
CMYK color mode: saturation of colors is increased but color shifting occurs and the shadows will fade out.
LAB color mode: no shifting of colors but increasing contrast due to the separation of the brightness information from the color information.
Besides the investigated effects other factors need to be taken into consideration for the choice of the appropriate color mode. The conversion of data to CMYK (= separation) requires accurate knowledge about the final print process and the necessary color removal. The use off LAB in turn will lead to loss of details with 8-bit color depth in critical areas of the image; Furthermore some tools in e.g. Photoshop are not even available in LAB color mode (e.g. selective color correction).
It turns out that RGB color mode is the most reasonable one for editing digital images.

From color mode to color space ...

It seems even more confusing since there is a multitude of color spaces available for the RGB color mode. A color space is a certain RGB described by means of an ICC profile. At the beginning of the job the user faces the challenge of choosing the correct color space for the capturing, editing and archiving of their images. The color space chosen for the editing of the image (image retouching, image enhancements, unsharpmasking...) is being referred to as a working space. (Attention: Once again this is not the RGB color mode but a color space characterized via an ICC profile, e.g. eciRGB or AdobeRGB!) Prior to the decision for a certain working space, some issues need to be considered.
Working spaces are described by the following parameters:
- the color values of the primary colors red, green and blue
- the gamma value
- the whitepoint

Primary colors

The definition of the primary colors affects the size of the color space in the first place. One needs to pay attention for a big enough resulting color space for the desired output process, since during the cre-

ation process or during conversion to the working space those colors will be clipped already, which could have been useful in a later high quality premium output process (e.g. for Gravure or Offset printing processes). In order visualize the different color spaces graphically the 2- or 3-dimensional illustration of the "ColorSync service application" under Mac OSX can be used. For all others a standard browser with VRML-plugin can be used for a comparison of the size of two color spaces via the website http://www.ICCview.de/.

Gamma

The gamma value defines how the gradient of brightness is based on the profile, or how many values at a time will describe the highlights and shadows. The lower the gamma, the more values are used to describe the differentiation of the highlights and if higher the more are used to describe the areas in the shadows. In practical use a gamma of either 1,8 or 2,2 can be found, whereas we find a slight preference for a gamma of 1,8 in color spaces coming from the area of prepress and a 2,2 in the display areas. Recently there are also such color spaces, which replace the gamma with the brightness distribution of the LAB color space which is equivalent to the reception of the human eye (L*, pronounced L-star).

White point

The "color" of white in a profile is described by the Whitepoint. In this case white is an area reflecting light over the range of visual colors. This color is primarily dependent on the illuminating light source. Two "normative" light sources have been established along with the according Whitepoints: D65 and D50. These describe the coloration of a reference object at a temperature of 6500K and 5000K. Since the illumination of D50 has been established in prepress and print it is useful to apply a working space with D50 and to calibrate the monitor to it, if you are working in this area. (Also see chapter 1.4 "Viewing conditions" and 1.5 "monitor calibration".)

General considerations when choosing a working space

Those color spaces describing an input- or output device, are of limited use as a working space. Because of its "nonlinearity". This means that a color with equal RGB values (e.g. R=G=B=127) will NOT result in a neutral grey and therefore e.g. optimizations in contrast will occur accompanied by a distinct color cast. Thus those working spaces are especially favored which feature normalized RGB color spaces and will generate a visually neutral grey.

Appropriate working spaces

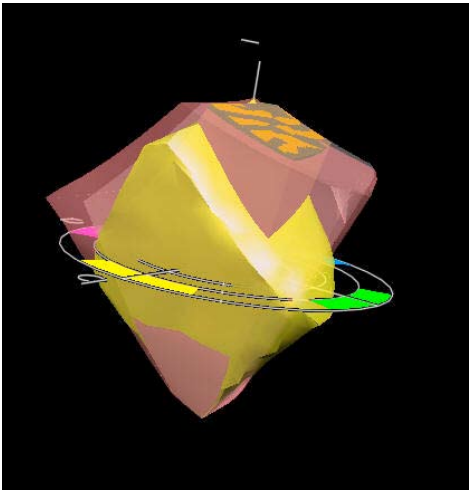
A brief while ago the European Color Initiative (ECI) aimed at the development of an RGB color space, which will cover the current established printing color spaces as good as possible, without becoming too "big". Since the Apple operating system took a commanding position, a gamma of 1.8 was chosen. As a Whitepoint D50 was specified and the primary colors were ajared to the NTSC specifications. The ECI color space is very well suited for editing, delivering and archival of image data, since the color space covers all current printing color spaces fairly well. ECI-RGB can be downloaded free of charge from the website of the ECI (www.eci.org). If you are working in an environment though that does not support color management please bear in mind not to use any image data in eciRGB that has not been converted prior to application. These are e.g. webapplications and Office environments. For this purpose a conversion to sRGB beforehand is recommended. Another meaningful working space is AdobeRGB, since it features the same gamma value as sRGB and some applications and cameras as well use it as a default setting. Especially with software products that do not attach color profiles we need to pay good attention to the compliance of camera software working space and image editing working space. Additionally unnecessary color space changes should be prevented, since the loss of quality due to multiple conversions can not be eliminated to full degree. (Note: Older Nikon digital-SLRs apply an inferior color reproduction in AdobeRGB than in sRGB. In order to ensure a trouble-free workflow one should always conduct a number of color tests prior to switching the working space of the digital camera.) There is an interesting approach to this from PhotogamutRGB (http://www.photogamut.org/) The idea was trying to cover all current photographic output- and printing processes and to eliminate all colors not contained from this working space. On top of everything a harmonization with sRGB was aspired in order to reduce color falsifications due to the transfer of image data into a workflow without color management. Please note the application of a so called LUT-profile in order to characterize this color space, which is over 150 kb in size and therefore increases the file size to this amount. It has not spread in practice so far, but its definitely worth keeping an eye on its development.

Special color spaces

We have not dealt with the extra big color spaces like CIE-RGB or WideGamutRGB up to this point. Those cover a visible range as big as possible but should be applied in special cases only. It must be pointed out that the quality of a future color separa-

tion will be higher if the size of the working space and the designated target color space will not differ significantly. Additionally these color spaces can not be displayed any more on a monitor. Note: It is not possible to display working spaces like eciRGB, AdobeRGB, PhotogamutRGB on a standard monitor at the moment. This means it is not possible to visualize the differentiations in highly saturated colors. Some special software applications for monitor calibration offer a workaround (which can partly eliminate this drawback) as well as some special monitors. These monitors have only been available for a short while and distinguish themselves with a large color space besides a rather high price of cost beyond Euro 4.000,-.

Color spaces for Internet- and Consumer applications



Comparison of color spaces: Yellow indicates Photogamut RGB, red ECI-RGB, grey and almost as big as ECI indicates Adobe RGB and the smaller color space within is sRGB.

When producing and editing data for internet applications a very special approach has proven itself, which takes the peculiarities of Internet applications and "Consumer monitors" and printers into account. Normally Web- and Office applications will not support color management. In order to be able to communicate resembling colors to some degree, the IEC with the cooperation of some rather big manufacturers (HP, Kodak, Microsoft) specified the sRGB color space not so long ago. Normally monitors and consumer desktop printers are appointed to reproduce the sRGB color space close enough. If images are placed in Office documents or in a web browser, a true-to-color reproduction can be achieved best, if the data has been characterized with sRGB as well. So there is the following recommendation for Office- and internet applications: Choose sRGB as output working space. This color is best suited for most applications, which do not support color management, for example Office software or generally the Windows operating system. In addition many photolabs that offer the output of digital data on paper prints will not take attached ICC-profiles into account but simply assume that the data was processed to sRGB. Many digital cameras will produce sRGB image data by factory default setting. Some more advanced cameras will sometimes offer a different color space. It needs to be pointed out that the use of sRGB as a working space is not rec-

ommended in a professional like environment, since sRGB describes a relatively small color space, leaving out some colors that can very well print in e.g. Offset printing process (particularly in the Cyan range, but in yellow as well).

In Conclusion

There is no ideal working space for everything, but there is an appropriate one for every intended application. In the premium prepress area eciRGB is a good alternative, AdobeRGB is a well spread worldwide standard, which can already be provided by some input devices like scanners or digital cameras. But there are already some new innovative solutions emerging on the horizon, which will eliminate some of the disadvantages of todays well spread working spaces. Some advice at last:

1.) Exclusively use calibrated and profiled monitors for displaying your images at all times and a software which supports color management for displaying.
2.) Stay well away from editing in CMYK unless the client resists on it.
3.) Always attach the ICC profile used when saving the image data.
4.) Pay attention when choosing your designated output space to be covered fully by your working space.

1.4 Viewing conditions

It is due to the fact that digital data can not be displayed without the aid of such devices as a monitor or printer, which makes calibrating and profiling the device used essential since data will not be displayed correctly otherwise.
Just as important as the calibration and profiling of these devices are the viewing conditions under which the images will be viewed. It is rather clear that these conditions can not be ideal at all the times for example for situations like in the area of photojournalism or when shooting "on location". It gets rather important for the photographer to have the kind of experience at hand in these situations in order to estimate the kind of effects these conditions will have on the image displayed. This guide can not provide this kind of experience but it can highlight the conditions, regarded as ideal when viewing images. Those of you wanting to take this one step further can have a look into ISO 3664 (Viewing conditions – Graphic technology and photography).

Walls and luminance

The walls should be painted either white or grey. A colorful paintwork or even colored floors need to be avoided. The luminance of the surroundings around the monitor should be according from 60% to 10% of an white area on the monitor. Illumination needs to be as constant and even as possible. If daylight is used for illumination there needs to be some sort of protection from direct sunlight. Aluminum blinds are suited best for this purpose if their lamellas are rotatable and arranged horizontally. The lamellas are color neutral and if using the appropriate angle the light can be directed to the ceiling and the amount of light can be adjusted. This will provide the ideal illumination without disturbing reflections.

Tip: Point a lightmeter with attached calotte to a white area on your monitor and measure illumination. Than put the lightmeter against a white wall and measure the amount of light falling onto the wall with the attached calotte (not the reflecting light). The monitor needs to be two f-stops (range of 1-3 f-stops is o.k.) brighter.

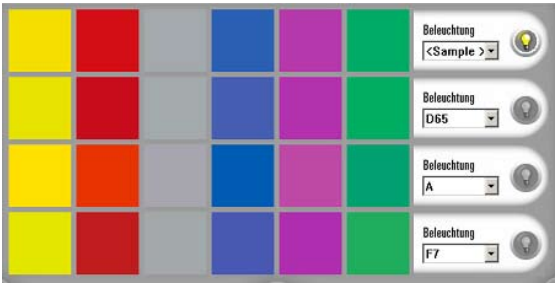
Try to avoid scattered light and direct reflections on the monitor. This will work best by attaching the lights (normlight fluorescent tubes) parallel to the window and equipped with glare shields. The monitor needs to be aligned parallel to the window area in order to prevent reflections and scattered light and should be equipped with a monitor hood.

Tip:

If there was no such hood included with your monitor, you can custom build one yourself (make them 35 cm wide) with a couple of black expanded plastic slabs, available from any specialized vendor for graphical supplies, and attach them to the monitor with some velcro. The cost adds up to something like Euro 3,- and they are just as good as the fancy accessory from the vendor.

Quality of light

Daylight is nice for illumination but it changes its color (spectral composition) in relation to the weather situation and time of the day. Halogen lamps, light bulbs and regular fluorescent tubes are not appropriate enough for the illumination of an image editing workstation. The illumination of choice are fluorescent tubes for standardized lighting, thus fluorescent tubes with a spectral composition, which gets very close to natural daylight. It doesn't have to be the expensive special tube from the manufacturers of viewing boxes for proofing purposes. The tubes from Osram or Philips will do the job very well and don't cost a lot more than a regular tube in the electronics department store. Look after the classification from Osram "Lumilux de Luxe xxWatt/950" and from Philips "TLD de Luxe xxWatt 950". Thereby the most important criteria is the 950 whereas the 9 stands for the highest quality of light and the 50 stands for 5000K. The power varies with the length of the tube. With the release of this guide Philips will bring a special TLD tube with the classification TL-D 90 Graphica Pro, which can be recommended.



One and the same color looks quite different under different viewing conditions. This is why the viewing conditions are so important.

Those who need it precise can use a standardized color viewing box, available e.g. from Just Normlicht, Kaiser Fototechnik or Mega Stahl.

1.5 Visualisation on the monitor

As a user we must not forget that we can not actually see digital images with their "zeros and ones". We will always need an utility for the visualization, like e.g. a monitor or a printer. We will never achieve a correct presentation on the monitor if the utility has been misadjusted (like too dark or too contrasted). But what actually means a correct presentation in this context?
As a start we need to conceive the fact, that a correct presentation of digital images is only possible when using image editing applications that support color management according to ICC specifications. As described in chapter 1.3, the image will be edited within a working space in this application. The description of this working space has to be included with the image in the shape of an ICC profile. The image editing application knows the color of each pixel from the digital value of each pixel and the according ICC profile (discrepancies from color management modules and rendering intents are left ignored at this time). For the pixel to be presented correctly on the monitor, the image editing application needs to know which digital value to send to the graphics card, in order to create the same color. This occurs likewise via an ICC profile for the monitor. The following will describe the process of creating such a profile.

Calibration of the monitor

First of all the monitor needs to be calibrated. What does that mean? A monitor that has been set e.g. too dark or too dull will never be able to display an image correctly. This means the monitor, in order to display as many colors as possible, needs to have a color space as big as possible and needs to be adjusted perfectly from the hardware side. Part of these optimum settings are besides the geometry, brightness, contrast and whitepoint in particular.
While brightness and contrast can be checked with test images available in tools like the DQ-tool from the german association of photo industries, on the ECI website or in software from BasICColor or X-Rite, a spectralphotometer or at least a 3- or 4-range measuring device is necessary to analyze the whitepoint.
Also the presetting of the brightness characteristics, so far this has been called the gamma of the monitor, is part of the calibration process. This gamma is based on the mathematical description between the interrelation of the input signal to the monitor in the shape of voltage and the emitted amount of light (see link to Charles Poyton). Since this gamma will be managed from the graphics card or the monitor electronics of modern computers/monitor, the usual principles are not valid anymore for the control of todays LC-displays, the calibration

with the help of a gamma is currently replaced by a new optimized description. The calibration towards a linear L* is being discussed in this context. With this the L-axis (brightness-axis) of the Lab color space is meant, which describes the lightness reception of the human eye. Therefore the monitor should be set up as ideal as possible for the human eye with a calibration according to L*. If the software for monitor calibration does not offer a way to calibrate according to L*, then a gamma should be chosen, that comes closest to the human perception and that is a gamma of 2,2. This setting can be used on the Macintosh as well as on the PC. The historical reasons for setting the Macintosh Gamma to 1,8 came from the prepress area and presently have no more relevance.

The choice of the whitepoint is another controversial issue when calibrating a monitor. The ideal whitepoint is the one that comes as close as possible to the regular viewing conditions for images. A study from Kodak proves the spectral composition indoors tends towards a color temperature of 5000K. In addition there are special sources of light with a spectral composition based on the color reception of 5000K respectively a standardized light source with the classification for D50. That means to set a whitepoint of D50 on the monitor. There is an exemption for CRT-monitors and especially older monitors which due to their light density contrast range will produce a very yellowish presentation when choosing D50 as a whitepoint. If you have such a monitor, you better choose 6500K as color temperature respectively the whitepoint of D65. An image, displayed on such a monitor will come across a little bit cooler in direct comparison with the original under D50 standardized light, but matches rather well to the original relative to the white areas.

The ideal settings for the monitor calibration are according to this:

check brightness and contrast with a test image or with the aid of a measuring device.

Choose the luminance characteristics if possible according to L*, otherwise choose gamma 2,2.

Choose 5000K as a whitepoint and 6500K only in the mentioned exemptions.

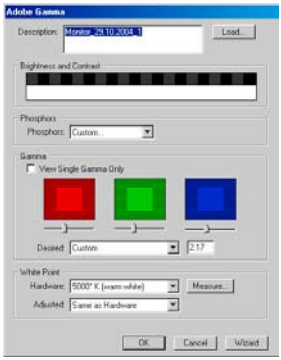
Creating an ICC profile

Subsequently to the calibration an ICC profile has to be created for the monitor. This can be accomplished with the aid of a monitor measuring device and the according software. In the process of the profile

creation different colors will be displayed on the monitor and then measured by the device attached to it. A profile will be created from the data collected and needs to be set as monitor profile by default in the according operating system. Applications like Photoshop will automatically apply the profile in order to display the images correctly on the monitor. Ever since Photoshop this can fortunately not get deactivated anymore and the user will always get the true-to-color presentation, provided the color settings in Photoshop are correct (see chapter 1.7).

Take caution with Adobe Gamma and similar tools

In the past the premium quality measuring devices were rather expensive which is why there were some attempts to accomplish the calibration of the monitor with the help of simple auxiliary tools. Therefore Adobe offered a small application called "Adobe Gamma" and Apple within their monitor settings. These applications were operating by the "rule of thumb" principle and a professional at the controllers could achieve a halfway reasonable result. If an untrained user operates the controllers catastrophic results were rather often the results. The use of a monitor measuring device can prevent that. Currently a good monitor measuring device will cost from €250,- plus and it really is a must for everybody, who deals professionally with images. Without such a measuring device, displaying images on a monitor is like flying blind.

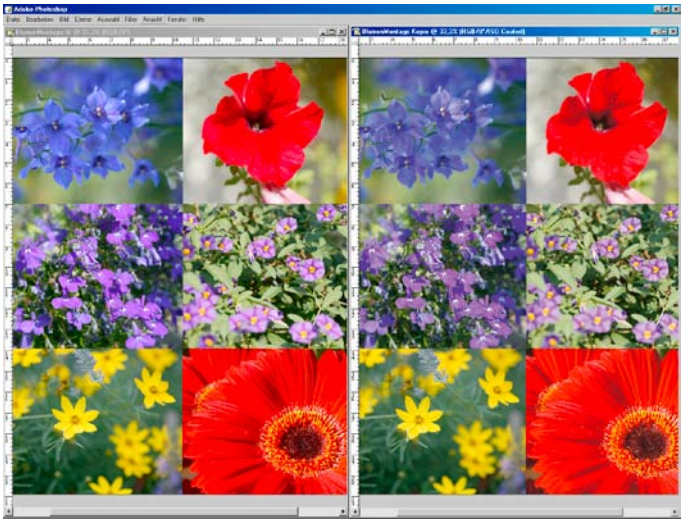


Softproof

With the aid of a monitor profile the user will always receive a correct presentation of the image on the monitor (naturally only within the physical boundaries), regardless of the color space the image is in. Thus it can be available in different RGB working spaces, in a device color space or even as CMYK in an printing process color space. In order for the profile to be actually used by applications like Photoshop, it has to be set as system profile for the monitor. This can be achieved on the Mac under "System preferences/Displays/Color" and on the PC under "Control panel/Display/Settings/Advanced/Color Management". Most monitor measuring devices will set the profile automatically as Systemprofile after calibration and profiling. A little supervision whether the newly created profile really was set in the System settings is

ok anyway.
Since the monitor respectively the image editing application doesn‘t care about in which color space the image is in, it can additionally simulate the output on a different device if there is a description of it in the shape of an profile available. This simulation can be chosen in photoshop under the menu for Ansicht/Proof einrichten/Eigene (see also chapter 1.7). In this case the images will get converted to the chosen simulation color space in the background and only then get displayed on the monitor. Thereby the displayed image will be limited to the range, which can be produced by the output device.

This pictue shows the original RGB file on the left and the softproof presentation for the offset output process on the right hand side



1.6 Visualisation in print

In the range of digital photography for consumers we can not automatically assume the user to be familiar with things like color management. Thus all devices in that range are set in the way for all recorded images to be displayed fairly neat on an average monitor. Likewise the printer drivers of all common inkjet printers are tuned in the way all images printed will look halfway like the image was seen on the monitor. Since the sRGB working space comes very close to an average monitor there are usually very little problems in consumer workflows but not necessarily the best results possible.
The field of professional photography applies different working spaces (see chapter 1.3) and there is a demand for a higher precision. The image displayed on the monitor is supposed to match the printout as close as possible. This can only be achieved within the physical boundaries of the according output device / printer. But the wishes can come true within these boundaries.

Profiling

It is essential to have a profile for the according output device, which is characteristic for the device-material-combination used (printer, paper, inks, driver). In the forefront it is important to calibrate the output device. It is supposed to deliver optimum results and constant output over the time. This is not working for some Color copiers since the output result is dependant on air temperature and humidity. But modern ink jet printers deliver a constant result, as long as the air humidity does not exceed 70%. For the creation of a printer profile a color chart will get printed depending on the according driver software which will be measured subsequently with a spectralphotometer. If you are afraid of the investment for such a device you will find a professional service provider in every big city, who will create the profiles for you. Possibly Google can be of help finding one --> search for: ICC remote "profiling service" to get a list. Just send the printed charts to one of the service providers and you will receive the created profile back. This needs to be copied into the profile directory of the according operating system in order for applications like Photoshop to recognize the profile. TIP: under Windows XP just right-click the profile and choose "Install profile".

Preview of the print

Since most printers are limited in color reproduction due to paper and ink combinations used, it is good to display the final result of the print in advance. Photoshop can realize this with the help of the profile. The exact procedure will be described in the next chapter.

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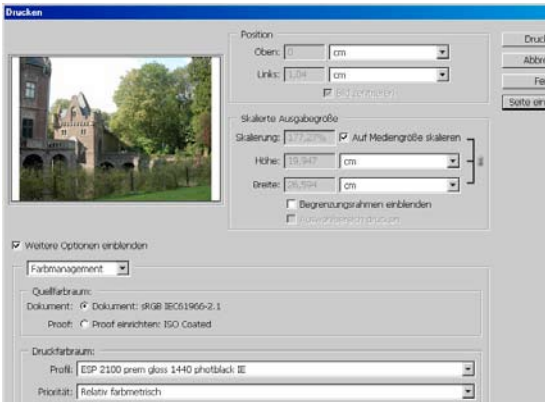
Print with Preview

In order to print correctly the printer profile needs to be chosen in the "Print with Preview" menu. Thus will convert the image before sending it to the printer driver in the way that it can be printed correctly. This printing alternative is called "Full Gamut Print" since it takes full advantage of the printers color space. At this point a so called Proof can be activated as well in order to simulate different output processes on the according printer like e.g. offset printing for that purpose. To exercise control over whether the simulation of the printing process was successful, there is the Mediastandard print for offset printing which is based on the mediawedge published by the FOGRA and UGRA. It is about color patches that will be printed and measured with a spectrophotometer. Each and every one of the color patches respectively certain groups of them have to comply with certain tolerances, so that the print can be regarded as compliant to the offset print.
A similar process for the control over RGB image data is under standardization by the DIN.



Print with Preview Dialogue above. An output profile can be choosen. Below the Mediawedge (more information from www.fogra.org)

Printing with a RIP

From applications like Photoshop images can be printed trouble-free with simple profiles. A RIP (Raster Image Processor) is essenttial if a layout with graphics, images and text is printed from applications like Quark Xpress or inDesign. Such a RIP can be avoided by creating a PDF file and printing it directly from applications like Adobe Acrobat.
In the professional area this workaround can be too time-consuming most of the times and the image setters for the printig films and plates still require the RIPs. They do have a couple more advantages. For example regular printjobs can be collected and printed space-saving or big posters can be split into a lot of smaller prints.
When planning to purchase such a RIP pay good attention whether it supports ICC color management. The profiling of such a RIP is a bit more complicated since they can adress the printer colors directly. This will initially require e.g. the limitation for color-application and a linearisation. If you are planning to build a profile for your printer-paper-RIP combination you might want to consider to consult an expert.

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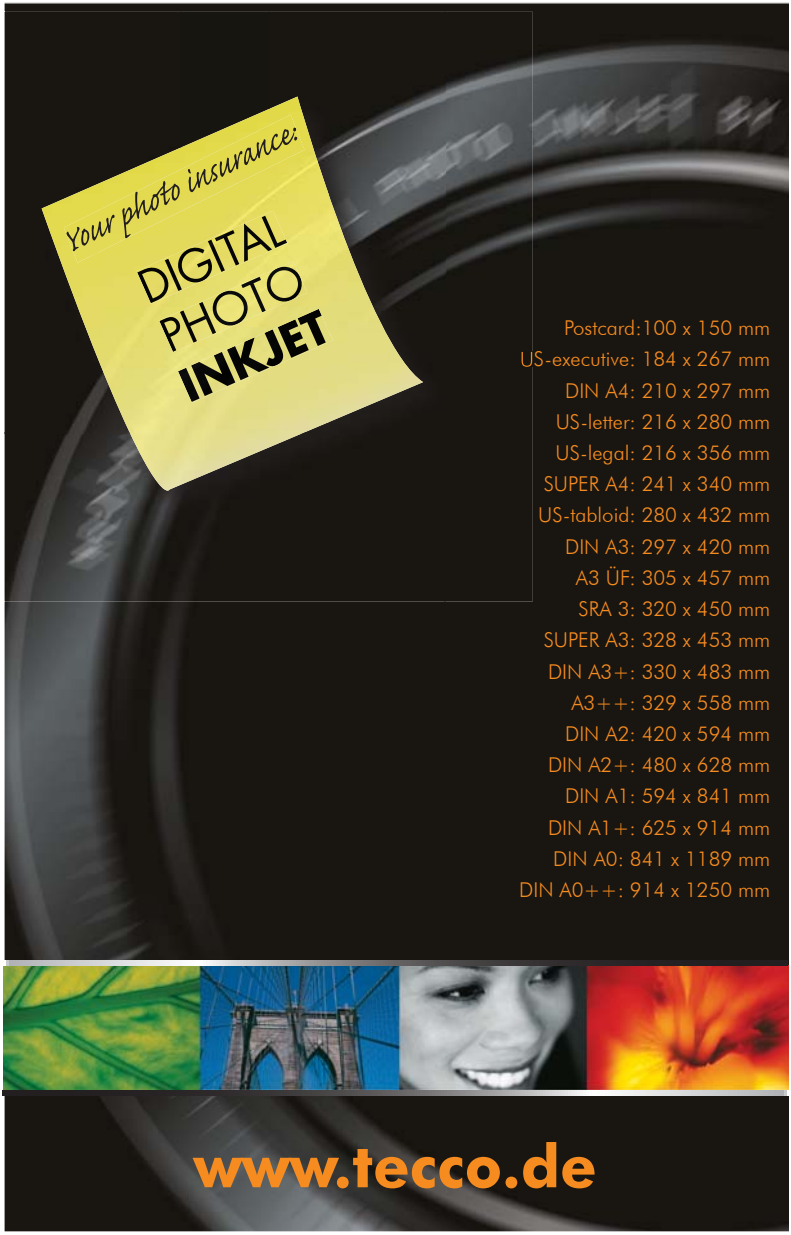

Your photo insurance:
DIGITAL
PHOTO
INKJET
Postcard:100 x 150 mm
US-executive: 184 x 267 mm
DIN A4: 210 x 297 mm
US-letter: 216 x 280 mm
US-legal: 216 x 356 mm
SUPER A4: 241 x 340 mm
US-tabloid: 280 x 432 mm
DIN A3: 297 x 420 mm
A3 ÜF: 305 x 457 mm
SRA 3: 320 x 450 mm
SUPER A3: 328 x 453 mm
DIN A3+: 330 x 483 mm
A3++: 329 x 558 mm
DIN A2: 420 x 594 mm
DIN A2+: 480 x 628 mm
DIN A1: 594 x 841 mm
DIN A1+: 625 x 914 mm
DIN A0: 841 x 1189 mm
DIN A0++: 914 x 1250 mm
www.tecco.de

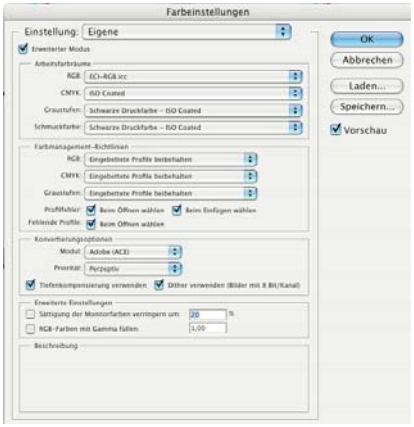
1.7 Settings in Photoshop

At first we find that color settings in DTP applications via program settings are being discussed quite controversial in some areas and even among experts. Certain "Sets" have yet been proven in practice in such ways to reduce the probability of "color accidents" - thus can not totally prevent these. Furthermore in the settings only such profiles are being used, which allow for standardised production processes, and – this should not be underestimated – are available free of cost to the user (www.eci.org). Image editing can not be imagined today without Adobe Photoshop and thus shall be used for the choice of settings as an example. These can be transferred to other applications supporting color management. With the completion of this guideline Adobe Photoshop is available in version "CS" or "8.01" for Windows (2000,XP) and MacOSX (10.3) as a component of the "Creative Suite". Adobe has attached great importance to the compatibility of both platforms during the development. This was accomplished quite well both on the first view (user interfaces, menus, palettes) as well as "under the hood". Particularly the handling of colors and the important associated profiles will lead to roughly the same results on Apple as well as on windows-based systems. Differences can be found mainly for the locations of settings – we will cater to this later. The screen captures used in the explanation were taken under OSX . The illustration doesn't differ fundamentally from windows systems.

Color settings

The color settings occupy a central importance for the presentation and internal conversion of colors, and will be opened via the menu item "Photoshop"-> "Color settings". It is important to activate the expert mode first. The dialogue is divided into five different zones: settings for the working spaces, association of the profiles (color management guidelines), the conversion rules for the CMM and eventually the extended settings and the descriptions. The ECI gives out the following recommendations for a working space: As RGB working space eciRGB should be used. This working space is very well suited for the elaboration of image material and has achieved great acceptance in central Europe on a broad basis. Furthermore eciRGB covers all colors that can be reproduced with all current output / printing processes. Under special circumstances – e.g. the exclusive use of digital SLR cameras as a source for images – this recommendation can be diverged from. (see 1.3). Choosing a CMYK working space depends on the subsequent assignment. The ISOcoated proved itself in most cases. This color space describes the standardised

printing process according to ISO-process norm 12647-2 for coated and noncoated papers in a sheet offset printing process. ISOcoated is also recommended for the presentation of greyscales and spot colors. (Note: This can be achieved by selecting the ISOcoated.ICC profile from the popup-menu next to the according working space and choosing "load greyscale settings" or "load spot colors"). If the optimization of data for a printing process is neither necessary nor wanted, than "Grey Gamma 2.2" needs to be chosen as greyscale working space. For the color management guidelines the setting "keep embedded profile" should be maintained . "Profile errors" and "missing profiles" define the interaction with missing profiles or profiles that do not comply with the chosen working space profile. At this point, there is the recommendation to select all options. This will trigger photoshop to open a dialogue whenever an image does not contain a profile or a profile does not comply with the chosen working space and also the user will get the opportunity to convert into the working space or to assign an alternative profile when opening the image. For the conversion options the setting "Adobe (ACE)" has proven itself due to the uniform handling on different platforms as well as the "perceptive" setting. Blackpointcompensation as well as Dithering can be activated as well. In the extended settings no options are necessary to choose. Sure enough all these settings appear complicated enough, but the ECI has come up with a solution to this problem and publishes installation applications on their homepage, which offers ready-to-run color settings. These can be activated via the topmost popup-menu "Settings" and already contain the ICC profiles for the working spaces – thus won't need to be installed separatly. In conclusion the standard installation presets (e.g. Standard settings for europe" should not be chosen.

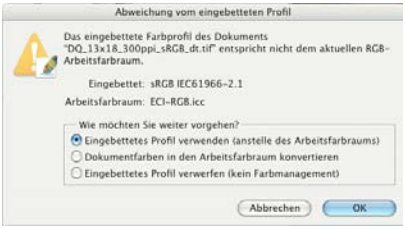


Opening image data

When opening image data Photoshops behaviour will vary after setting the according working spaces. The follwing scenarios may occur:

1.) No profiles embedded: If the image data does not contain a profile, Photo-

shop will show the following dialogue while opening: The user obtains the options to either open the image without a profile (in this case the according working space will be used in order to visualize the RGB- or CMYK-values), assign a working space or assign an alternative profile and optionally convert to the working space. 2.) Profile embedded that does not comply with the working spaces: The embedded profile does not comply with the according working space (RGB or CMYK) in Photoshop while opening an image, Photoshop will show the adjacent dialogue. The user has the option to either keep the embedded profile, to convert the image data to the working space directly or to discard the profile. 3.) Embedded profile matches with working space: If the the embedded profiles in the image data match the working spaces (RGB or CMYK), Photoshop will accept these image data without further notice, provided that no RAW-data is involved (see also Chpt. 4.1 and 5.1 – Raw data; the behaviour of Photoshop will be described further down).


Abweichung vom eingebetteten Profil
Das eingebettete Farbprofil des Dokuments "DQ_13x18_300ppi_sRGB_dt.tif" entspricht nicht dem aktuellen RGB-Arbeitsfarbraum.
Eingebettet: sRGB IEC61966-2.1
Arbeitsfarbraum: ECI-RGB.icc
Wie möchten Sie weiter vorgehen?
Eingebettetes Profil verwenden (anstelle des Arbeitsfarbraums)
Dokumentfarben in den Arbeitsfarbraum konvertieren
Eingebettetes Profil verwerfen (kein Farbmanagement)
Abbrechen
OK

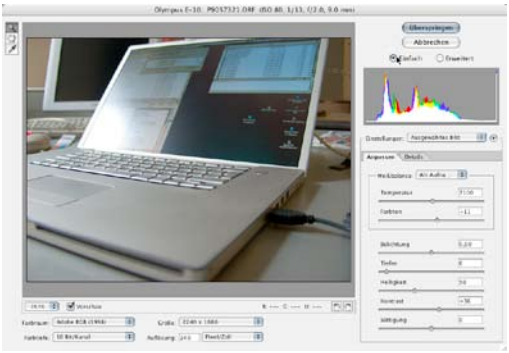
With this multitude of options, it is essential to find the appropriate strategy fur the further processing of images. In principle the are options, to assign a profile (which means that the pixel values in the image will NOT get changed but the the colors displayed will vary greatly) or to convert (into the working space, in this case the pixel values will be CONVERTED, thus CHANGED – the display on the monitor probably changes marginally). A generally accepted declaration about which strategyis better can not be made at this point. It seems to make sense though, when opening an mage to merely ASSIGN a profile, which describes the image accordingly (keep embedded profile). This assigned profile can still be changed at a later time – when CONVERTING this is nopt possible anymore. This approach should be preferred also since there is no visual feedback (preview of the changes) possible on the monitor. On the other hand if a different profile will be assigned via the menu item "Image -> Mode -> assign profile" the changes will become visible when activating "Preview".The same does apply to the conversion of image data via the menu item "Image -> mode -> covert to profile".

Opening rawfiles (raw data)

0.The opening of rawfiles (see also Chapter 4.1 and 5.1) takes an exceptional position. The so called "Camera RAW plugin" comes "in-the-box" with Photoshop 8, which enables opening rawfiles directly. The following strategy has proven the test of time:

1.) determine white balance / define neutral grey

While opening photoshop will use the white balance determined by the camera. This can be noticed in the right menu area under the "view" tab throught the white balance preset "As camera". If the white balance is not pleasing enough (neutral areas e.g. show an explicit color cast) a change can be applied in the first place throug either a global modificationby selecting "Auto" (or the type of light available while capturing). If this approach will not provide satisfying results, changing the color temperatur (lower values --> image will turn bluish, higher values --> image will turn yellowish) and the tint (negative values --> image will trun greenish, positive values --> image will turn magenta) can obtain a remarkable optimisation.



A further option is to adjust to a neutralgrey area in the image itself. This will be acieved by choosing the grey balancetools in the window on the left and selecting (click) the the area of the image to be matched. Therupon Photoshop the colortemperature settings and the tint until this tint is defined as neutral (Comment: If "AdobeRGB" is selected, neutrl grey areas of the image will always hold values of the color components R=G=B. If the mouse pointer is within the image the values will be shown on the right side unter the image window).

2.) Define Exposure

After adjusting the whitepoint respectively the definition of neutral grey it is recommende to define the exposure. The highlights in the image will be influenced with the Ruler "Exposure", the shadows in the image with the shadows ruler. When holding down the "Alt"-key while dragging the ruler, Photoshop will highlight the parts in the image that are assigned as white ("Exposure" ruler)and hich parts of the image are assigned as "black" (shadows ruler). Comment: These visible parts of the image shown in these demonstrations will hold no picture details whatsoever, therefore they are "flat" or "clipped".

3.) Adjust brightness, contrast and saturation

Choose the whitepoint either from an entry in the list, by moving the slider or via clicking the pipette within the image.

The rulers for "brightness", "contrast" and "satuation" will accomplish a further adjustment of the image itself. The functionality of these rulers is rather familiar in the filed of color corrections and does not require further explanation.
4.) Apply sharpening
Sharpness can beapllied to the images optionally even while importing the images . The sharpness settings can be found in the right menu area underneath the "details" tab. Please note in order to judgesharpness appropriatly a 100% zoom isessential. Therefore it is rcommended to change the zoom to100% before changing the sharpening parameters.
5.) Set parameters for the conversion
Before actually converting the image a few parameters need to be defined. "AdobeRGB" can be recommended as color space – at least as long as Adobe Photoshop does not offer atlernatives for Working spaces like ECI-RGB" or "PhotogamutRGB" in the Raw-plugin.
If the image is already according the the users anticipation by now and no further optimisation of tonal range and colors is necessary in Photoshop, it can be openend with 8.bit depth. In all other cases the image should be opened with 16-bit color depth.
The menu item "Size" offers – depending on the typeof camera used – different options to either enlarge or reduce the image size. The quality achieved is clearly superior to the regular scaling of images in Photoshop. Now if its clear while importing the data to use it for a large-format-poster, then the scaling should be apllied in the RAW-plugin.
300 pixel per inch have proven to be appropriate resolution since it is very close to the theoretical resolution limit of the human eye. Once the settings have been aproved with "ok" Photoshop will calculate the final image from the camera data. This can take a couple of seconds according to the amount of data and theperformance of the PC or Mac.

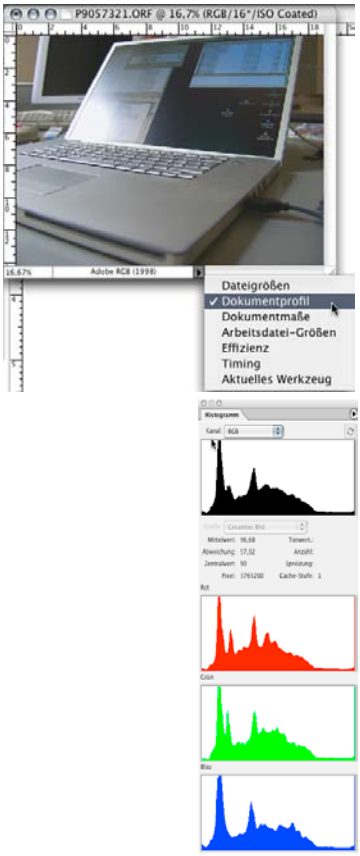
Visualisation

Photoshop CS makes a couple of technically matured tools available for the visualisation of images.
An appropriatly calibrated and profiled monitor is a requirement in any case, which can display a color space a big as possible (see alo in chapter 1.5 Visualisation the monitor).
When visualizing colors we need to consider the fact, that the monitors and displays used today are NOT able to display all colors of an RGB-file (e.g. in ECI-RGB or even in sRGB) correctly. This is also true for the printing colors used in an offset printing process – even though the offset printing color space according to ISO 12647-2 for uncoated

paper is significantly smaller than the RGB color spaces mentioned above, a highend monitor is necessary in order to display all colors available in print on the monitor.
If a visualisation of animage in a certain colo space is conducted, only those colors will be shown which the monitor is able to display.
But we have to find in relativation that the majority of image material used will not exploit the color space of neither print nor RGB color space. Thus in most cases the visualisation of colors on the monitor will give us a pretty good impression of te final results. If animage is availble in a RGB color space, the colors will be displayed virtually as accurate as possible from Photoshop and the color engine of Photoshop. It is helpful in most cases to receive and evaluate a preview of the expected results in print on the monitor. One will refer to this kind of preview on the monitor as a "Softproof".

Within the menu"Preview" choose the menu item "Softproof --> Custom...". In the following dialogue choose the profile, which describes the subsequent printing process.
Tip: Most of the times it does make sense to choose the CMYK working space selected from the Colorsettings at this point. This one resides at the very top in the shortlist. "Relativ colorimetric" will be chosen as standard rendering intent. For images with highly saturated colors it is recommended to choose "Perceptive" in order to obtain the details in these colors. The boxes for Blackpointcompensation and paper simulation should be activated.
Attention: In case the images shal be printed in Offset- or rotogravure it is urgently advisable to apply the standard profiles from the ECI-Homepage. The preinstalled profiles in photoshop with names like "Euroscale" and so on should not be used.
After approving the settings the preview can be toggled on and off with a key shortcut (Mac: command-Y; Windows: Strg-Y)
In doing so the titlebar of the image window will show which color mode the image is presented in(Attention: Only the color mode will be displayed), how the data is coded and which color space is simulated.
Next to the visualisation it is also helpful to be able to recognize the color space of the actual image at all times. For this Photoshop offers the possibility to display the chosen profile for each particular image in the information section / status bar. Therefore it is necessary to switch to "Document profile" in the information section (by clicking the tiny arrow on the right hand side of the section). The newly designe histogram palette is an additional essential tool of Photoshop

CS. This will not onlysow the histogram of the file, but additionally the colored histograms of each individual color channel. The palette can be accessed via the menu item "Window --> Histogram". In the histogram setting (tiny arrow in the upper right hand corner) the display of a statistic can be shown as well as activating the display of the single channels.



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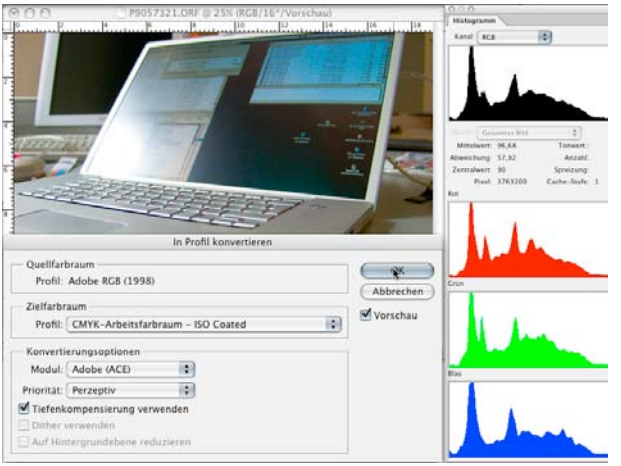
Separation of images

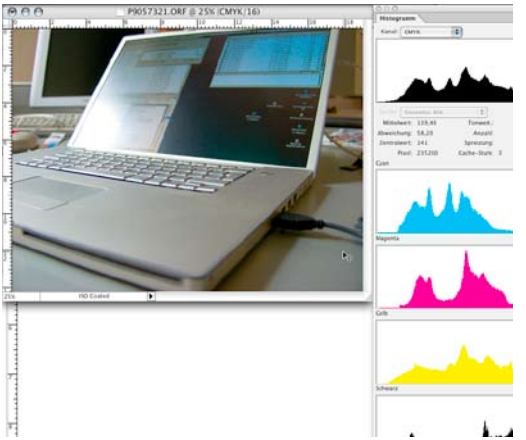
For certain jobs it can be necessary to completly the data for print. In this case it is the photographers assignement to convert the RGB data in ready for press color separations ("CMYK data"). (Attention: This kind of conversion should only be performed on special requestfrom the clients side. In case the images are supposed to get edited at some later time, an RGB (ECI-RGB, ...)color space makes a lot more sense as a transfer color space !!)

Formerly these separations were created with so called "Separationtables". This technique has been replaced by the use of ICC-profiles. It must be pointed out that the quality of the separation (and thereby the subsequent usability on the press) is primarily dependent on the apllied profiles. For this reason it is explicitly refered to the standard profiles from the ECI homepage at this point.

These profiles will achieve a top-quality result under all sorts of printing conditions and paper types. It is disadvised to apply the profiles Euroscale" "Swop" "Japan" installed by Photoshop. The separation of the data can be initiated via the menu item "Image --> Mode --> convert to profile".

In the dialogue the designated color space will be chosen and the rendering intent appointed (when applying the "relative colorimetric" please note that a great deal of details will be lost in highly saturated colors). By activating the "Preview" box the result can be visulised before actually processing the data. Once the separation occured the image data is available in CMYK color mode.





2 Photography

2.1 Exposure and lighting

In principal the following applies to all digital cameras: as in analogue photography the illumination is dependent on these three factors like photosensitivity – in this case in regards to the sensor – the exposure time and the preset camera aperture.

ISO-sensitivities

With analogue cameras the photographer determines the sensitivity through the choice of fi lm material. With digital this isdifferent by nature, since the recording medium is a CCD- orCMOS-sensor , that is built into the camera.
Therefore the sensitivity is always dependent on the image sensor and is indicated by ISO-steps just like with analogue film material. In opposite to fi lm it can be changed – which means that the photographer can choose certain ISO settings and switch the camera from ISO 100 to ISO 800 or signifi cantly higher settings.
These changed settings should be subject to caution though, since the physical basic sensitivity of the CCD- or CMOS-sensor will stay the same: The higher values can be achieved via an electronic amplifi cation of the image signal . Subsequently this also implies the basic background noise to get amplifi ed as well. Many simple consumer cameras with high ISO settings will not produce images acceptable for the professional beyond ISO 400. Premium digital SLR camera systems and of course the professional digital backs will still produce very good image material in many cases even beyond ISO 1.600 or even ISO 3.200. With these images full of atmosphere can be produced even without the use of specific artificial light – though ideally suited for event photography indoors or even shooting at night.

Studio- and fl ashlights

When it comes to lighting for digital cameras there is not even signifi cant rethinking required. Professional SLRs or and even digital backs will cooperate brilliantly with common Studio fl ashlights or a system flashlight. Only high resolution scanning backs will partly require a flicker-free steady light system (like HMI), could mean trouble for a photographer.
Please keep in mind that current available digital cameras offer a significantlysmaller dynamic range than the rather well-tempered negativefilm material from analogue photography. Therefore extreme differences

in contrast can create problems, thus either "loose" the dark details in the shadows or clip the highlights and loose the details in this parts of the image. (see also "tip" on the next page).
A digital SLR is usually equipped with a x-synchro contact for triggering a studio flash system. All studio flash systems can e triggered that are equipped with this kind of contact. Naturally remote transmitters via infrared or other ways to trigger a flash are possible.
Generally one needs to pay attention to the white balance setting of the digital camera when shooting under artificial light. Either the camera will be manually adjusted in terms of color with a white piece of paper or a greycard or a whitebalance preset for flashlight respectively daylight needs to be chosen. Naturally the use of a designated measuring device for the creation of individual color profiles for the specific camera is recommended, in order to produce constant color values. For the same reasons it is essential for a studio flash system to deliver a power / flash intensity as constant as possible as well as constant color temperature. Some studios will perform complete measurings of the according flash systems, in order to utilize only those systems for the subsequent set assembly, that all feature matching color temperature.
For a reportage assignment one is responsible for seeing that the digital SLR and the according system flash can communicate with each other: In many cases a regular TTL-measurement for the flash intensity is NOT possible but one has to fall back to the specified TTL-technology (D-TTL, E-TTL) of the camera respectively the matched upon system flash. That's why many manufacturers offer new product lines of system flashlights for their digital SLRs, that are adapted to these special characteristics.

Aperture settings of the camera

The Aperture setting of a digital camera is similar to a regular analogue camera. In relation to the used lens maximum and minimum aperture settings are allowed, referring to the size of the opening in the lens that determines the amount of light falling onto the CCD-sensor and in cooperation with the exposure time affects the correct exposure of the image. With simple consumer cameras the aperture is often set via cursor keys in the settings menu on the LCD-monitor, with a digital SLR the aperture setting can be achieved definitely more comfortably by means of a rotating knob or directly at the aperture ring on the lens.
As a result of emerging deflection effects with extremely small aperture settings digital photographers are recommending f16 as minimum aperture setting, even better with only f11.

Exposure - problems

Even with the seducing high image resolutions, which are sometimes even higher than those of SLR cameras many of them are not appropriate for professional use because the exposure clearance is too small for various reasons.
It starts with the lowest possible ISO-sensitivity for the camera, which is simply too high for most tasks. Almost all models are starting wit an ISO-value of 100 and some even at ISO 160: In case of a studio-shooting this can mean that the flash system can not regulated low enough and therefore one has to work with simply too much light. This can be extremely fatal for example with portrait photography for which a larger aperture opening in order to outline from an out-of-focus background. But in this case only a too small aperture settings and therefore too much depth-of-field will be applied with a consumer camera. The minimum aperture setting with many consumer camera is only f8, because of the small measures of the mini-lens as well as the recording sensor – and subsequently the according overall geometry inside the camera – aperture settings beyond f 8 would result in deflection effects (see also "Aperture settings")
Outdoor shootings with sunshine are therefore only possible with extremely short exposure settings and won't allow any motion effects by dragging the camera in motion while taking the picture.
A neutral density filter is pretty much the only thing that will help to tease out a couple of f-stops.

Tip: Underexposure is better than overexposure

High dynamic ranges images – thus extreme contrast between light and dark – it is recommended set the exposure on the highlights and to put up with an underexposure in the dark areas in an image. Since the dark areas in an image can be retrieved by a contrast- or tonal range optimization – even though this is not visible on the monitor at first – the information in the highlights can not be saved from the completely white elements of an image in case of an overexposure in the highlights.
In order to optimize the exposure the professionals will use the raw data format most of the times, in order to develop the images "digitally" systematically. Additionally the conversion of raw images to 16-bit data is a big advantage in terms of postproduction, because a lot more tonal gradation is available for editing the image in Photoshop after the conversion into such a 16-bit tiff file. There the dark portions can be brightened selectively in order to receive a more balanced final result.

2.2 Formats, Color depth and compression

Digital cameras save its images in the shape of digitally coded – thus converted to numerically values- files. The formal design of these files can be very different. A couple of standard formats have accomplished themselves which all have their advantages and disadvantages and therefor coexist in digital photography.

Color depth

A file of an image usually exists from the three basic fundamental colors red green and blue. We describe the color depth as the bit-quantity, with which these shades for each one of these colors can be displayed. In 8-bit we can digitally save 2 to the power of 8, thus 256 different numerical values. For each individual pixel a brightness value between 0 and 255 will be saved for each of the three RGB color channels. Every pixel can consist of 256 green, 256 red and 256 blue tonal values – thus from totalling 256 x 256 x 256 = 16,8 million colors.
Increasing the color depth will result in the ability to reproduce even more shades. Many digital cameras for this reason work internally with a significantly higher color depth, than will be saved at the end of the capturing- and editing process in the 8-bit image file. 12-bit are quite common for example which process 4.096 tonal value shades per color excerpt, respectively even 14 bit, with which even 16.384 shades can be achieved per color excerpt.
Even though the human eye is by far not capable to differentiate the 16,8 million colors of an 8-bit display, the higher color depth is important. The reason for this is the different brightness reception of humans and digital cameras. The camera is able to differentiate very well in the bright areas and the eye in the dark ones. With the larger amount of shades and the human reception a better photo dynamic can be achieved with the optimized gradation of brightness. The higher color depth is also used in image editing for additional contrast- and tonal value optimization.

Compression

One of the biggest problems in digital photography consists i having to save the immense amount of data on a storage medium. A 6-mega-pixel image consists of altogether 6.291.456 pixel. For each pixel the camera has to save the color information for red, green and blue. Each color information consists of 3 x 8 bit (256 shades) per color (see color depth), thus the image consists of 6.291.456 x 24-bit, which are 150.994.944 bit respectively 18.874.368 Byte (approx. 19 megabyte).
Storage media for digital cameras are not cheap though. For this reason one was looking for possibilities to minimize the data. The solu-

tion was found in the "compression" of the files, thus in mathematical procedures to save the data more space-saving. As a fundamental principle we need to differentiate between two techniques:
losless compression (e.g. Tiff-LZW)
lossy compression (e.g. JPEG)
A lossless compression is characterized as a procedure in which the original file in spite of compression of the image can be reproduced 1:1. A simple lossless compression consists of saving redundancies (repeating information) in a concentrated form – rather than singular. The Tiff-LZW format applies this procedure but achieves only very low compression ratios, since the pixels of a photo practically all hold very different color values.
For this reason the Joint Photographic Experts Group proposed a new compression technology – and while at it even named it after itself: JPEG. It takes advantage of the weakness of the human eye to differentiate color differences less exact than brightness differences. JPEG reduces by a mathematical procedure "discreet cosinus transformation DCT" the color information of the image by summarizing the color information of multiple pixels to one information, the brightness values will stay untouched. Due to the loss of some of the original information the images will not be reproduced into the exact original condition – thus will be saved lossy. This loss is accepted because
a) the loss of quality with a cautious JPEG compression are not visible and will stay tolerable even with a stronger compression.
b) the space saving of JPEG is immense: The initially mentioned 19-megabyte file of a typical photo will be reduced to just under 3-megabyte even with a weak JPEG-compression.

JPEG-format

JPEG has established itself as a standard with digital cameras. While featuring a strong compression power it offers further benefits:
the actual intensity of compression is scale able. The more intense – the smaller the files will get – yet the quality loss will increase. Digital cameras offer the chance to between different JPEG grades. The photographer gets to decide whether he prefers a smaller file size or better quality.
JPEG can be opened, edited and saved by practically every single image editing application available. But it is not only for image editing applications but also for the internet one of the most essential formats for photos.
Graphic- and layout applications increasingly utilize JPEG-images
Many cameras will save the images directly as JPEG , which can be essential due to the amount of storage necessary as well as the processing speed. In postprocessing the photos shall be saved into the

JPEG format at the end of the processing due to the lossy compression while saving.

TIFF

Tiff-files are normally saved without compression. Every pixel contains the complete information, provided by the camera.
This usually leads to large image files. Tiff also supports 16-bits color depth. This is an advantage since a lot more shades are available for each color nuances. Practically every layout- or graphics application is compatible with Tiff.

RAW-format

The raw formats take an exceptional position among the image file formats. The information coming from the recording sensor will be saved without further compression or interpretation. As an outcome the camera will not actually save a digital image in the truest sense of it, but saves "raw data" on the memory card. A normal image editing application can not read this information – because of saving the raw files and the according raw formats depends on the according camera manufacturer. Thus the raw data can be manually edited to every detail with the appropriate application, even the optimization of whitepoint as well as the subsequent sharpening of the photo is possible appropriate image editing application / an RAW-converter.
Since the possibilities of editing are so immense, the raw formats belong to the most popular file formats in the fields of professional photography. Instead of leaving software sharpening, tonal correction via Gamma-coontrol, behavior of colors as well as other parameters to the interpretation of the camera, the photographer can convert according to his own gusto with the accompanied or third-party conversion tools. Adobe Photoshop offers since version 8.0/CS the possibility to read many of the manufacturers own raw-variations. To open such a raw-file kind of resembles the development of an analogue film in a classic photo lab, with the opportunity to take influence on the outcome of the photos to a large extent.. For this reason more and more consumer digital cameras feature the digital raw format.
By this the color depth of the recording system can be obtained and will not get reduced to 8-bit. This guarantees a for higher dynamic range in the photos.
The main disadvantages of raw files lies within the slightly more complicated and thus time-consuming handling because the photos have to be processed compellingly, in order to get displayed and used further on the computer.

DNG

Adobe is fond to replace the specific manufacturers raw data formats with a consistent "digital negative" and put a proposal on the table during Photokina. This kind of development is eligible from the users perspective, whether the manufacturers will jump on it needs to be awaited. The DNG is an enhancement of the in ISO 12234-2 standardized Tiff-EP (electronic picture).

JPEG2000

An interesting, but frankly in digital photography so far not a very widespread format is JPEG2000. It does offer a lot of advantages like e.g. the losless compression and high quality with strong compression. Owners of Photoshop CS get the chance to read and write JPEG2000 files The optional plugin is actually application CD under goodies.

Tip:

It is advisable whenever it needs to go fast and an individual postproduction is not possible, to choose JPEG with a low compression = high quality. But if it is possible in difficult situations to save in the raw data format, then it should be applied. Additionally a subsequent control of the histogram is recommended directly after the exposure (if the camera makes this possible).
Some of the modern digital SLRs are capable of saving raw data and JPEG-files simultaneously on the memory card.

Links

www.jpeg.org/

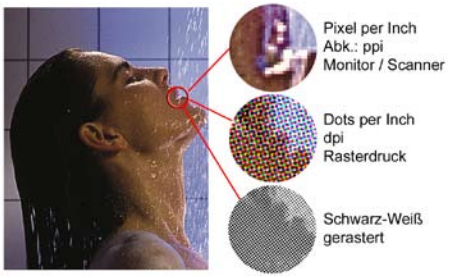
2.3 Resolution

The term resolution is often equated with the number of pixels (actually referred to a sample rate), that a camera delivers. This equation is only applicable under ideal reproduction conditions, from which real cameras are more or less far-off. A bad lens in front of the camera means that even with an extremely high number of pixels not a good an detail-rich photo can be captured. The quality of the reproduction is dependent on the camera and lens used and hence con not bet conducted any further at this point. The following observations will thus relate to the idealized reproduction in the shape of pixels.

How big of an image file is necessary in order to get printed precisely? Every photographer should ask himself this question, before sending his photos to the printer. Because only if there is suffi cient enough data available for all the details of the motive, they can get reproduced perfectly. Especially with illustration books, magazine photos or further large formats one can accept no compromises at this point.

A careful planning process already starts before the actual capture, since there is no way to add the data afterwards. For instance changing the size afterwards- the so called interpolation – will not increase the resolution in terms of detail reproduction. Since this will create additional pixels purely through average determination the photo will come across dull and out of focus after the operation. For this reason the right setting needs to be chosen, even before the shutter release button is pressed.

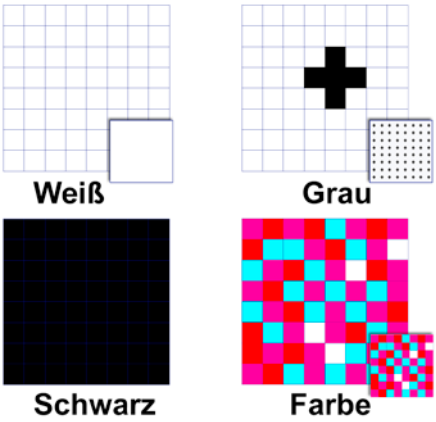
Resolution on screen and on paper



Just how the image format affects the fi le size, is describe in the previous chapter. However kilo- and megabytes say little about to which degree a photo can be printed on paper in a high quality.
This is particularly affected by the print format and method. The number of pixels depends on the specifications, from which the exposure needs to consist of marginally.
These dots are additionally referred to as pixels, an artificial english word from picture and element. The pixel as a fundamental element is no constant dimension, but is very different depending on each output medium. Thus they can be quadratic or squarish depending on the

resolution or rather tiny colored smudges, that can be on top of each other in contrary to the monitor.
There is a basic rule to this: The more pixels are available the finer the image can be dissolved. Yet the transfer of image data sets a limit from which oversized amount of data makes no sense and cannot be handled anymore.
A good resolution is achieved if the pixels create the impression of constant color and brightness gradients, without the single elements becoming visual. On the monitor 96 dpi can comply with these requirements on the distance of an inch (ppi), without the ye recognizing the composition (one inch is equivalent to 2,54 cm). On a piece of paper there have to be even more colored pixels on this distance, because a photo or an image will be observed mostly from a shorter distance. A printer for example should be able to produce approx. 300 "real colored" print dots per inch (dpi) in order for colors and shapes to come out clearly. Wanting to reproduce a photo on a piece of paper in the same size as on the monitor it must contain theoretically approx. nine (3x3, width x height) times as many pixels.

The printing screen will dissect such a "real colored" pixel.
Only Thermosubliminations printer, autochrome printers or image setters have the capbility to create a printed dot for each pixel in the appropriate color. These can suffice with just 150 dpi if necessary in order to receive very good results.



An inkjet printer or an offset machine is technically not capable of producing such continuous color gradients. The so called Iris-prints are exempted, that actually operate with "continuous tone" thus continuous color gradients. A regular inkjet printer though has to place the basic colors in such a way on top of each other, in order to simulate a merged color to the eye. A purple smudge on closer examination thus consists of a collection of dots in magenta and cyan, crowding itself in a so called "screen cell".
These screen cells match the according print dots. A further unit referring to resolution is: lines per inch (lpi). Nobody is actually still working with "lines" this nomenclature is actually from early printing days.
Thus one can find in a newspaper photo with 100 lpi 100 screen cells on one inch. These screen cells themselves consist from a multitude of

smaller dots. The offset print with a screen is the regular process for newspapers, magazines, books and editorials. Subsequently you will find the according resolutions for each print item. If necessary one needs to ask the editorial office or the printer itself.

Newspapers:	65 to 100 lpi
Books (uncoated paper):	120 to 133 lpi
Books (coated paper):	133 to 150 lpi
Magazines:	150 to 175 lpi
Art books and -magazines:	175 to 250 lpi
Thermosubliminations printer:	206 to 400 dpi

Practical example calculated

Back to the photographer and his photo: The measurements with digital cameras are indicated in absolute pixel values – approx. 1600x1200 pixel. Additionally they could be specified in ppi (Pixel per inch).
Misleadingly the specification in dpi (Dots per inch) has achieved acceptance as a term for image resolution. And thus creates confusion, since dpi only refers to the actual printed dots, with which the pixel of the digital image will be processed.
According to the utilized printing screen the following formula can be applied, as long as its specified in lines per cm:

screen width (cm) x 2,54 = screen width (lpi)

To play it safe a quality factor is added for the calculation of dots per inch, which is ideally specified as 2. In practice due to the human reception values between 1.4 and 1.6 have been established. So the formula sounds like this:

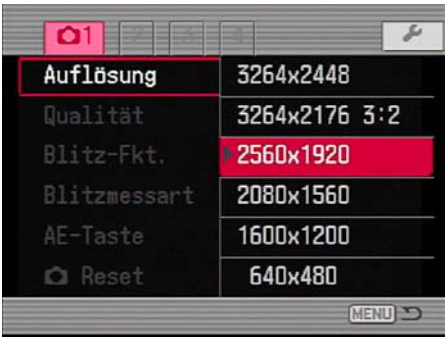
screen width (lpi) x quality factor 1,6 = dpi

as an example we will perform this calculation for the monitor display:
A photo has the dimensions 800 pixel times 600 pixels, thus altogether 192.000 pixels. Every pixel of the file on the screen will be displayed as a pixel on the monitor, which usually operates from 72 dpi to 96 ppi. The result is a width of the photos is 8,3 inch (800 divided by 96 ppi) or 21,2 centimeter.
Because many beginners believe, that each pixel of the camera is in accordance with each printed dot from the inkjet printer the following error originated: One thinks the printer will print the image with an resolution of 1.440 dpi. This would result in an image with 800 x

600 pixel that will be printed with a width of approx. 1,4 centimeters (800/1.440 x 2,54) and a height of 1,05 centimeters.
Frankly this assumption is wrong due to the above described rasterisa tion process: Since the output system can only assemble the digital pixel only through a screen / sample from different printed dots, in order to create millions of shades from its original colors, it has to feature a resolution multiple times higher than the image resolution of 200 to 300 ppi. These 200 to 300 ppi will then get printed with 1.440 dpi. The screen of an inkjet printer usually will not create so called screen cells, as in the common offset printing process, but utilizes statistically spreaded dots. It is "frequency modulated".

Color- and greyscale printing screen

A screen cell can be filled with colored or black dots. According to its density and composition the outcome are either shades of grey or a certain tone of color.
With a black & white print for example the screen cell could consist of a matrix with 8 times 8 printed black dots. Form this we can accomplish 64 shades from white (empty cell) to black (filled cell). In a professional production print most of the times 4 colors are used: Cyan, magenta, yellow and black, CMYK if abbreviated. These are also commonly utilized in regular inkjet printers.
As shown in this screenshot the different resolution settings can be defined in the settings menu of almost any digital camera. If one knows what size the photo will be printed, one could make an exact choice: (printwidth in centimeters / 2,54) x resulting dpi = necessary image width in pixel.

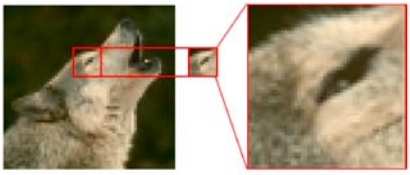


The height is a result of the exact aspect ratio and does not need to be calculated separately. Frankly one will seldomly meet the exact image dimension like this and thus will rather acquire the dimensions, in which the available image material ca be printed.
(width in pixel / acquired dpi) x 2,54 = printable width in centimeter.
(height in pixel / acquired dpi) x 2,54 = printable height in centimeters

Tips when photographing and exposing

At last a couple of considerations when shooting: The pixels are not always based on the actual information of the hardware. Some cameras promise high resolutions by adding calculated pixels. This process is called "interpolation". Since this method is based on approximation,

a certain out-of-focus and dull colors will often creep in. Thus the interpolated resolution can be ignored and only the optically available pixels should be used.
The same is true for the use of the so called digital zoom. Instead of enlarging an image scene with a powerful lens, the digital zoom functionality will blow it up with calculated pixels. The consequences are out-of-focus images and reduced contrast in this case also. As a matter of fact there is no reason to worry about insufficient optical achievable pixels these days. In the meantime almost every digital cameras comes with at least 3 megapixel, 4 to 5 megapixel are standard, premiumconsumer cameras capture the images with 6 to 8 megapixel and certainly solutions exist that can go beyond 11 and 22 megapixel.
Similar rules apply to having the digital images printed at your local camera store as to the above mentioned thermosubliminations printer, because an output process is adopted, that can control color for each individual pixel and it is not necessary to raster. An image resolution of 200 dpi is sufficient enough as image resolution.
Most photo dealers or online print services will state the necessary resolution for the desired image size mostly in absolute pixel dimensions, because that matches the information coming from the digital camera. For a 4x5 inch (10x15cm) print a resolution of 1.600 x 1.200 pixel is recommended.



Interpolation der Bildpunkte beim Digitalzoom

Links

www.agfanet.com/de/cafe/photocourse/beginner/cont_index.php3?lesson_id=1&page_id=5
www.agfanet.com/de/cafe/photocourse/digicourse/lesson4/cont_chapter05.php3
www.dpreview.com/learn/?/Glossary/Digital_Imaging/Resolution_01.htm

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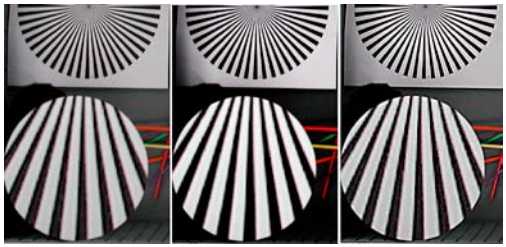
2.4 In-camera sharpening

Many digital cameras offer to choose between different Sharpness settings via the in-camera menu.

When shooting a digital photo not only lens system and chips take part, but numerous calculations will be performed, until the image is actually created: The light captured by the sensor as voltage will be transformed into a digital signal , the color temperature will be applied according to the menu settings and the image will get converted into an image format like JPEG (see also 4.1).
The image will get sharpened on this way also. The degree of internal postproduction can be determined via a menu, but in most cases only as a rather rough choice between the three settings "soft", "normal" or "hard". The electronic sharpening has nothing in common with the focussing of an image. A wiggly image due to a long exposure time will not turn sharp because of it. In fact it is supposed to compensate this kind of out-of-focus due to technical reasons, caused by the interpolations of colors or resolution from the camera. A similar technology is also applied when scanning images.



The illustration is showing three diferent versions of Sharpness settins, created from the same cameras. The "soft" setting is shown on the left, "normal" in the middle and the results of the "hard" setting is shown on the right.

The description in the settings menu says very little about the actual results, since the chosen sharpness very much depends on the calculation methods by the manufacturers. As shown in the screenshot, edges can be emphasized by very different methods. The first untreated example shows a relatively wide transition from black to white, which creates an out-of-focus impression. In the second screenshot the area is crushed, by strongly increasing the bright-dark-contrasts – one method of sharpening. There is a risk though for color gradients to get torn up. With the "unsharp masking" method (USM) only small sections will be considered.
In the extreme case – as you can see here – sharpening will create significant fringing. Particularly with enlarged displays will annoy just as much as out-of-focus.
Every manufacturer applies his own definition of "normal" or "hard". Even the setting "soft" will not be left out from an internal sharpening during interpolation.

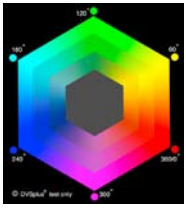
European Color Initiative
www.eci.org

There is the advantage of in-camera sharpening since the sharpening algorithm is adapted to the "contrast transfer functionality" of the camera. This actually functions better than e.g. Photoshop algorithms. A soft cautious sharpening from the camera can be recommended in many cases.
Many photographers choose a softer setting on purpose since the electronic sharpening can be performed just as well in an image editing application. The degree of sharpness via USM-filter can get adapted exactly to the individual image because the filter impact needs to be adopted exactly to the resolution of the image, the printing process and the dimensions of the subsequent print.
Besides simple filters that are part of the standard equipment of image editing applications in which the user can manually adjust the USM-parameters there are also some third-party filters specialized on digital sharpening processes, that can perform the necessary settings via automatic or semi-automatic. The sharpening automatic could as a special service also incorporate vignetting with wide angle lenses as well as increases noise with high ISO-settings. But mostly small digital cameras for example will apply stronger sharpening, in order to compensate for shortcomings in the lens and low resolution.
Otherwise it is up to the photographer whether he trusts the in-camera software rather than the visual handling. At least increased noise in the images could be prevented b manual sharpening with a couple of tricks, but the internal processing will write it into the photos irreversibly.

2.5 Color space

The term "color space" is occupied by multiple meanings and thus it leads to some confusion.
Colors can be describe in different mathematical and physical three-dimensional models. Thus the term "color space". The "color models" Lab, RGB, CMYK are part of these scalings.
The RGB or CMYK values from a certain device like a camera or monitor can be visualized within the Lab presentation, which is why it is also occupied with the term "device color space". This is also true for idealized working spaces like eciRGB or ISO-Coated (CMYK).

Digital cameras, monitors and Scanner use the additive color model for displaying the individual color shades, in which the three primary colors red, green and blue create the different combination colors. With maximum brightness these three colors RGB produce white in this combination, black in the opposite, if none of the three colors is visible.
The RGB model is equivalent to our vision, because in our eye these three primary colors are received by the photo receptors responsible for the color impression and our brain combines this color impression by mixing these signals.



The subtractive color model assumes white light, from which the colors cyan, magenta and yellow will be withdrawn as a spectral part. This way cyan withdraws red from the light, magenta the green and yellow the blue. All printed matters – whether they were created with an inkjet printer or in a printing plant - have to utilize this model. With them the combination of all colors will not result in white, but black – if color is absent the paper can be describes as white.
RGB and CMY are tightly linked to each other. If two primary colors from one model are combined a primary color from the other system is generated.: red and blue will emerge magenta, red and green will emerge yellow and the combination of green and blue emerges cyan.
In theory the conversion from color model to the other would seem rather simple. In a complete color model all colors from the additive system RGB can be converted to CMY – and vice versa. The two graphs make this quite clear.: If they are displayed in the HSB color model which describes colors as shades of color, brightness and saturation values, the primary colors of RGB and CMY are exactly opposite of each other. Red is the opposite of cyan, yellow the opposite of blue and green the opposite of magenta. If you turn the color wheel by 180 degrees than the colors will get relocated to the prior position of their opposite. Cyan is now located at the position of red, yellow on

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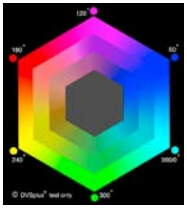
the position of blue and so on.



Frankly in practice it is not that simple. One of the problems with the CMY-color model is based on the situation under full color coverage of the three primary colors it is supposed to become black, but this black will not be achieved this way. Since the printing inks can not be manufactured pure enough , it creates a mixture of a dirty brown-green. In order to actually print black it has to be added as a fourth color (K for blac-K, Key or K-ontrast). For the calculation of this black contingent are two different methods available: With the UCR - under color removal that hold the same three printing colors to the same degree and thus will create greyshades as a result of the composition, will be replaced by the fourth color black. The degree of these greyshades, which are describe by a gradient curve, can be adjusted in an application specialised on this kind of separation.
The grey component replacement (GCR) on the other hand reduces all colors by a certain degree and rebuilds it by adding the fourth color black. Just like it the grey component replacement is described by the gradient curve in a separation application. Since there is no way to tell from an CMYK image, how it was built, a recalculation to RGB-mode is not possible in an exact fashion. Additionally when converting from RGB to CMYK another factor is applied during calculation, which describes the so-called dot gain. A very absorbent paper - as it is the case with for example newspapers – the inks will scutter and create larger print dots, which will influence the theoretically correct color- respectively brightness value. This factor can not get recognized either in the CMYK-file at a later point and thus aggravates the reconversion to RGB.

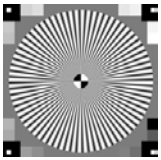
In practice these two individual color models feature a different range of color. In other words, the digital camera or the RGB display computer monitor can display numerous colors that can not be produced on a CMYK printer. Those colors beyond the reproduction capabilities of a CMYK printer need to get converted to those reproducible by CMYK. A pretty good example are highly saturated green tones or even strong orange tones. The according conversion is very complex and offers a couple of methods of resolution. For instance the maximum feasible color of the CMYK destination color space can be used as a replacement for the non-printable nuance (colorimetric rendering). Alternatively the complete RGB-color space will be compressed highly, in order to fit all of the non-printable back into the destination color space (perceptual rendering intent).
Color management system will help with the conversion. These consist

among others of so called "ICC-profiles", their design was defined by the International Color Consortium. ICC-profiles describe the differing color behavior from a reference curve of any device. Profiles for input- as well as output devices can be defined, whereas photographers do have a special interest on profiles for digital cameras and scanners. Most digital cameras will work in the sRGB color space, which already contains a large portion of the visible colors – and is quite frankly still larger than the RGB-color space which most monitor will display.
Just how the exact sRGB-definition for the according cameras will look, is still the manufacturers secret, because even with "standard" sRGB there are significant differences arising. Thus it is recommended to create an individual profile for the according camera (see also 1.2). The color management system will then "know" which color space can be captured by the camera. The photos created with this profile will now have to get converted to an output color space for output purposes. Associations like the german BVDM, FOGRA and UGRA make color profiles available for certain printing processes, that are constantly under development – among these the ICC profiles ISOcoated.ICC and ISOuncoated.ICC for offset prints on coated and uncoated paper.
It is important for the photographer, that he will merely be able to display the CMYK on his monitor in a limited manner.. The DVSplus system was developed for this reason , which consists of ICC-profiles and reference prints. The whole purpose of this technology is to offer the photographer a display on his monitor for his RGB-data , which is limited to the printable colors in an offset process. They are RGB-profiles that will practically allow a secured CMYK-display – as a proof on the monitor. They are especially recognized with highly saturated colors in the image. The could lead to arguments between the photographer and the client, because they can be seen on the monitor in brilliant colors, but they will not be recognized on the
sequent print result.
In other words: With DVSplus the image can be reduced to those colors that any printer is able to put on the paper. Thus the profiles can be used for CMYK separation. A controlled color space compression will be performed when applying the DVSplus profile, that will fit the Rgb color space of the digitally captured image to the significantly smaller Offset color space.

Links

www.fogra.org/
www.ugra.ch/
www.bvdm-online.de/

Imaging is our profession

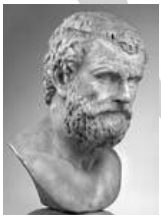


Digital camera tests

We test digital cameras and scanners for magazines like the German Color Foto and c't since 1997. In the mean time numerous manufacturers also use our services to test prototypes of their cameras. We also offer consultance as well as complete test stands including test charts, illuminators, and evaluation software.

Trainings

You can profit from our experiance in camera testing and practical image processing by the trainings we provide. We offer a wide range of courses from the basics of image processing up to the use of a digital camera as a luminance meter. The image enhancement for internet purposes and colormanagement aspects are also part of the program.



Digitalization

We digitize prints, slides, negatives, old books and historic dokuments. If you want to do this yourself we offer consultance and help you to avoid the expensive mistakes we made in the past. We have a lot of experiance in handling rare and fragile originals in combination with optimized performance.

Mass digitization of 35mm slides

Image Engineering offers a cost-effective high speed solution for the digitalisation of slides. A slide projector is modified for this purpose so that the slide is diffused and uniformly lit. A digital SLR camera which is fitted with a good macro lens, looks from the front into the projector and photographs the slide. Interested? Look at our website.

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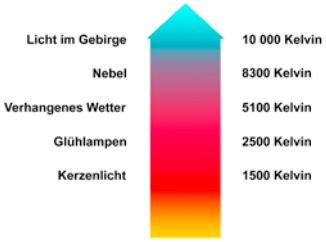
2.6 White balance

Images photographed with digital cameras can have strong differences in color according to the time of the day. At noon the sunlight consists of lesser portions yellow and red, but lies within the bluegreenish range. In the evening though the red spectrum will prevail. The same is true when capturing under lucent orange light bulbs or blueish fluorescent light tubes – a clearly visible color cast will be seen.
In order to prevent the unnatural coloring, the camera needs to be adjusted via white balance to the according light. In the analogue photography such films were used which chemical emulsion would react stronger or weaker to parts of the spectrum. The method is endorsed by the use of conversion filters. These colored lens cantilevers would fi lter the unwanted components, by letting especially the complimentary colors pass. In digital photography, either the white balance automatic can be used, the manual white balance settings via menu settings or the images will be edited in the computer afterwards.
The spectral composition of the light is defi ned by the so called color temperature, measured in Kelvin. Thus a theoretic model of an ideal black body is presumed, a black hollow balls with a hole in it. It simply swallows all incident light, but will emit red- to white glowing light according a heating through the hole. The rising sun thus complies with approximately 5.00 degrees kelvin, a clear blue sky complies with 11.00 degrees kelvin.



The eye will not recognize these kind of fluctuations, since the brain will partly compensate for it. Thus the camera needs to be adjusted to it via white balance. A blank sheet of paper should therefor appear white in any kind of situation, no matter when and where it was photographed.
Almost all digital cameras offer besides the white balance automatic predetermined presets to choose from, like "daylight" or "tungsten". Admittedly they will only deliver approximated values, the actual color temperature will not get captured. Even if acceptable results can be achieved by this, method will fi nd its limits with mixed light situations. This will always result in a color cast. The most exact white balance can only be achieved via a manual setting to the according color temperature, as long as this functionality is available is the camera. A sheet of white paper or a greycard can serve as reference – according to the camera. The only important thing in terms of the camera is not to have a color cast on it, the luminance value of it is not important. The complete color nuances

will arrange themselves to this neutral values. If the white balance was not performed correct during capture, but the color discrepancies are not too trong, than it can be corrected within an image editing application without problems. For raw data, which are saved unaltered by the camera software to a storage medium, this is actually the standard procedure.

2.7 Storage media

In-camera memory

There are a bunch of different types of memory cards, that have evolved around digital photography. Only a few though actually have a meaning in professional photography now. Generally speaking the photographer should not buy one large single card but rather a few cards with medium storage capacity in order to minimize the risk of data-loss with a broken card. If a card should indicate an error while shooting simply put it away safely in the first place. In many cases the data can be restored with a "Recovery" software. (e.g. JPEGdump).

CompactFlash

The memory card suited for professional purposes is the CompactFlash card, not meaning the IBM Microdrive. They are mechanically to fragile and should be used in professional photography. These cards score capacities of up to 4GB meanwhile.

SD Cards

An alternative offered in some cameras is the SD card. It is rather sturdy and can obtain capacities of to 1 GB. It also features a mechanical write protection.

All others memory cards like the MemoryStick, Multimedia-Card, XD Picture Card or the SmartMedia are without meaning for professional photography.

Memory for transfer and archival storage

The service providers in the production process are prepared for different transfer technology. Next to the electronic transfer via ISDN (see also "5.2 transfer technology") the CD-R has been established as a lowcost standard for the offline transfer of large amounts of data.

CD

So the transfer of large images and layout files takes place via one-time writable (CD-R) and rewritable (CD-RW) CompactDiscs. They are rather sturdy since they get along well without any mechanical parts inside. And if the chemical coating won't get damaged by either heat, UV-light or solvent, the CD-R can last up to 30 years, the CD-RW will last up to a year if used on a regular basis. It is commonly saved in data format ISO9660, an accepted norm by every operating system. A CD fits up to 800 mb.

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DVD

The Digital-Versatile-Disc thus can save up to 4,7 GB with one layer of data (DVD category 5). It is commonly written in the Universal Disc Format. Other formats like ISO 9669 are theoretically possible, but is not readable by the reading devices. But the most popular drawback are the competing DVD-Standards. The one-time writable (DVD-R) or rewritable (DVD-RW) minus-standards follow the official DVD-consortium, DVD+R and DVD+RW are vendor specific.
So when buying pay attention for the blank to be compatible with the DVD-burner and for the printer's DVD-drive to be compatible with the according standard. Those drives that are compatible with both kinds should be preferred. The old standard DVD-Ram had a tough start. Blanks of this kind could be rewritten more often than its relatives, but there is no software necessary compared to common CDs and DVDs to burn them. You can simply drag the files to the drive in the Windows Explorer. A DVD-Ram also offers the highest data security available.
The development will not be finished for long. Besides the already available Double Layer-DVDs with 9,5 gigabytes the so called Blue Ray-Discs are already announced, that will feature even higher capacities. Those will be able to save up to 30 gigabytes on the same dimensions as the CD or DVD.

Links

en.wikipedia.org/wiki/CD-R
www.informatik.hu-berlin.de/~hstamm/mo.html

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2.8 Camera maintenance

Dust and fuzz are the enemy of digital photography. All stops were pulled against the annoying teasers when enlarging film: Compressed air and antistatic appliances paired with a set of special gloves and a special fastidious treatment of sensitive slides, negatives or prints.
When scanning not only the original but also the glass plate needs to stay free of dust and fingerprints at all times, in order not to degrade yourself to a retoucher with laborious desmudging. But even in the camera the dust will raise the dust.

Cleaning the sensor

It used to be the film on which dust and fuzz would settle down, and was then simply replaced, the sensor is becoming the permanent dust catcher - especially if all doors are open for dust after changing lenses repeatedly. In addition to the tiny airborne particles, that my be removed just as well through the classic cleaning methods just like from the analogue camera (a simple bellow is recommended yet the cheapest method is a cluster ball but without talcum), smallest micro particles will stick to the sensor due to air humidity and a breath of lubricant.
Thus a simple blowout won't do the job anymore. The use of Q-tips is actually forbidden since there is the danger of tiny fibres getting stuck and affecting the mechanics. Chemically treated cleaning cloths for glasses must not be used either – neither for lenses nor for the LCD, since the coating of the lenses respectively the display can get scratched. There is also a strong disadvise not to use canned air either, since some photographers underestimated the temperature-and greenhouse gases problem. There are some rumors that lenses should only be changed with the camera switched off, in order not to "expose" the sensor when "loaded" , which attracts the particles faster and for fast shooting series to load up the sensor with static energy – theories with no evidence.
Eclipse is a liquid and Sensor Schwab are special cleaning cloths from Photographic solutions in the USA, which are designed by size specifically to the sensor (e.g. for Fuji S1 and S2, Kodak DCS, Nikon D1, Canon EOS 20D) and recommended by Kodak, Leica and Fuji for the cleaning of their cameras. The cleaning cloth should be customized to the size of the sensors and used actually just once from each side. The liquid is a high-purity methanol (use in constantly vented rooms only) which also evaporates completely without residue, while the cleaning cloth are produced and sealed in the clean room and will not fuzz or scratch.
A test shot is mandatory after cleaning: attach a lens, switch autofocus

to off and set the aperture to 11 or 16 while shooting a white piece of cardboard (preferably with an overexposure by 2 f-stops). The result may still show some delicate remainders of dust particles when zooming in the image editing application, which will never become visible though in a real photograph. The ambitious photographer should not carry the cleaning into extremes due to micro sized dust particles: the zooming steps of image editing applications have boosted the demands of many photographers.
Even though the sensor is covered by a glass anti-aliasing filter or optical glass and the cleaning process is just about the same as cleaning a lens, the cleaning of the sensor can become a fine motor challenge. If you do prefer not to be exposed to the danger to damage the surface of the filter, the lantern slide or the mirror by making a wrong move or using the wrong cleaning device, can still call upon the regular manufacturers service department.

It is almost always the blue sky that brings out the little dirty secret. Dust and fuzz on the sensor affect the image.

The high zoom level will show the artefacts, caused by dust and fuzz on the sensor.

Shake it, sensor ...

Olympus offers active dust reduction with the E-1 by a so called Supersonic Wave Filter, which is attached in front of the CCD and makes sure that dust and dirt particles will be waved off and caught durably by a specially coated foil. Each time the camera is switched on this functionality starts to work without any noise or vibration and removes any dust and dirt particles at least as efficient as any bellow, but more gentle and reliable. The service is recommended for fixed particles and exchanging the dust catching foil regularly.

The supersonic wave filter is assembled in front ofthe CCD. The ultrasonic waves produced by it are so fast and effective that accumulated dust and other dirt particles will fall off and get stuck to a specially coated foil. This function takes place each time the camera is started but can be activated manually too.

Image: Olympus

In the glittering light of the hot desert sun

Permanently damaged pixel can occur if the camera is aimed for a long time at an extreme light source with the Aperture all the way open. This will not happen with an digital SLR but the digital compact keeps the aperture opened in order to "feed" the display with a Live preview. But there is no need to start getting "chicken-livered" during the next sunset: As long as the camera on a tripod is not aimed at the glowing midday sun for minutes the sunset may be shot full of relish during all phases.

Afraid of pixel errors ? They can occur with consumer digital cameras and camcorders, if they are directed at a glistening lightsource for minutes. A sunset won't harm no pixels on a sensitive sensor.

In fog, wind and weather

The digital camera can be protected from

rain, snow or splash water with a plastic bag (Tip: the cooling bag from the frozen-food department in the supermarket) with an opening for the lens, because the electronics inside the camera are more than sensitive to humidity. A custom tailored protective case is safer in any case. Once you are back in your warmed-up home the camera needs to be dried off with a soft and dry piece of cloth. For digital SLR and compact cameras with a filter thread a uv-filter is the perfect protection for the lens just like the analogue camera. It is no big news of sand and saltwater to damage the body and for that matter is true for either analogue as well as digital cameras. If the digital camera should have been exposed to bad weather conditions or a long foggy morning, just switch off the camera and remove the batteries and memory card in order to dry it on the air for at least 24 hours.

On the way during frosty conditions

Frankly it is not only big heat and high humidity that get to the digital camera – while the LCD starts to slow down at low temperatures, the camera may even deny service shortly during frosty temperatures. If it gets truly frosty for a permanent period of time only a purely mechanical cameras will perform it is service reliably. If you are travelling by car with your camera, simply grant your camera bag a place inside the car, instead of keeping it in the cold trunk. Low temperatures will also get to the batteries and the consequences can range from a slight interference of power to a complete loss of power. The spare battery better spend some time inside a small container of either a jacket- or the pocket of your pants.
For your fingers to stay flexible even during very low temperatures, a gel pack inside your coat pocket is the perfect companion on a cold day. It contains a small metal plate, which activates the gel pack if folded and unleashes its warmth. But only once its not warm enough for the fingers anymore, it can be stored inside the camera bag. Digital cameras, batteries and rechargeable batteries shouldn't be exposed to temperatures over 40 degrees celsius for a long period of time.

Air trip

The typical question if travelling by plane: Is there a chance for the digital camera to get damaged when x-rayed during security-check on the airport. Will the metal detector damage or delete my data on the memory card ?
But that is of no danger. Even though it is theoretically possible to erase a storage position via strong ionizing radiation, but the appropriate power to do so is a loth higher than the power of the x-ray machines during security-check. However if you feel that the x-ray machines during security check-up are not up-to-date when traveling to

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the more distanced areas, simply remove the memory card and have it checked manually
If travelling with a digital SLR and would like to take the above described cleaning-set, you will be shaken down. The cleaning fluid is highly flammable and must not go on the airplane.

Apropos memory cards

The exposed contacts from the memory card like smart media are their achilles heel: they are vulnerable to corrosion and pollution. Rubbing with a regular cloth may result in static charge. By which voltage will get inside the card and fibres may dissolve from the cloth.
CompactFlash- and MemorySticks don't have contacts being exposed and because of that they offer more data security. Theoretically the CompactFlash- and SD-modules as well as the Memory Sticks are increasingly resistant to bit-errors than SmartMedia cards due to the built-in forward error correction. Microdrives are rather popular due to the extremely high capacity and comparably low price. They are true small harddrives though with a mechanic and vulnerable to crushes. In favor for security they should rather remain inside the camera and should be read via the USB- or firewire interface.

The userguides of memory cards with exposed contacts sent out explicit "thumbprint" warnings. They should be handled by the plastic parts only.

Source of supply

The cleaning fluid Eclipse from Photographic Solutions and the Sensor Schwabs, that are recommended by many camera manufacturers and in numerous photography forums, can be purchased from any photo accessories specialist.

Links:

Field report sensor cleaning:
http://nikondigital.org/articles/ccd_cleaning.htm
http://www.bythom.com/cleaning.htm
http://www.photo.net/equipment/digital/sensorcleaning/

3. Data optimization

There are those kind of pictures that are pretty self-explanatory. Thus nobody will find it hard to attribute a picture of the burning twin towers from September 11th. Our experience tells us, when the shot was taken, what it shows an where it was taken. These are the essential informations about a picture. But who actually remembers the exact date of the nemesis of the titanic (April 14th, 1912) or the firing of the "Hindenburg" Zeppelin (May 6th, 1937). The non-informed viewer is probably not even able to recognize what these pictures are actually showing. That is the reason why it is so important to add a bunch of information – so called metadata – which enable the interpretation and classification. There are two standards: Exif and IPTC, that apply to the description of images and are supported by most camera and software manufacturers. The data from both of these standards will be saved directly into the image data and therefore won't get lost accidentally. Since most image databases also support these standards, images can be imported automatically into numerous databases and thus will be found through a query. Additionally there is still one more standard, which is based on the programming language XML with the name of "Dublin Core", frankly it actually saves the image information in additional XML files, that can get lost during transfer of the images. That is why this standard only plays a noteworthy role in the area of historic archives.

3.1 EXIF

(Exchangeable image file format for digital still cameras, www.exif.org)
This standard is in charge of the "technical metadata". It specifies how the technical information will be saved in the image. A part of this information are date, time, exposure correction, white balance, ... a list of all the available EXIF tags can be found at the time of publication under http://www.awaresystems.be/imaging/tiff/tifftags/privateifd/exif.html and goes all the way to GPS positioning data., if the camera features a GPS receiver or the possibility to connect to one. Which data will be entered to the Exif header, is dependent from the according camera respectively the manufacturer. The manufacturer specific fields can only be read by the software to the camera.
Exif data is dedicated to record the technical capturing conditions. Thus they can not be edited formally. A programmer will not have a hard time changing it though, which is why they can not be used offhand as a copyright- or modification protection. In case of a technical problem of the camera or the assignment of an image the Exif

data often can add to a solution. That why it is important that the image editing application will save the Exif data rather than removing it when saving the image.

3.2 IPTC

(International Press and Telecommunications Council)
IPTC information is all about a so called describing metadata. Which means the IPTC data will describe where the image was taken and by whom and respectively who owns the image rights, besides the image content. These data won't be added automatically but rather need to get entered either by the photographer or another person. Some image viewers of camera manufacturers and also special "IPTC writers" allow the semiautomatic batch entering of the IPTC-fields for an image series. Photoshop supports the majority of the IPTC-fieds via the menu item file information and allows the editing of IPTC fields, at which not all fields are available all the time.

Please always put yourself into the position of the person viewing your images, when entering the fields. Which questions will he ask, The answers to these questions belong into the according fields.

The photo journalist needs to enter the following information in any case:
Photographer: Who took the picture?
Credit: Who will get the fee?
Date: When was the photo taken?
Caption: Image description, who is pictured: First- and family name, age, function, the event that was photographed, a detailed description for an object
City: In which city the photo was taken
Country: In country the photo was taken
Notes / special instructions: is there a problem with personal rights of people shown, somebody will need to get glared.Are there special claims? But also: Are there technical specialties to the photograph taken (digital camera, the photo is low key on purpose or with a color cast or limitations for publication?
Author: Who performed the image description, who can be asked in case of questions?
Source: enter your Email address here in case of further questions and if you are sending your photos for the first time to your client or an editorial office.

Beyond that there are such things, that do not belong into any IPTC-fields.
The information about your bank account are not of interest for example. Not because you are not supposed to get paid but rather because in case of a future database query for images from the city of "Berlin" your image will pop-up just because your bank account may be from a Bank in Berlin.
This data will be dealt with at a later time. They are not supposed to be in the photo. The same is true for your address. The only time the name can be supplemented by the city is if there is reasonable chance for a mix-up, for example Arthur Miller, Dallas.

3.3 Description - Naming conventions

Pay attention to the fact that others might be working on a different computing system. Which means, that umlauts and special characters (i.e. @, /, ©, ,) need to be avoided. A point and underscore is appropriate for naming. Filenames should not get longer than 26 characters, since some databases will simply cut off additional characters.
Any image should have the according file suffix attached, e.g. .jpg for JPEG or .tif for Tiff files and thus it does not matter whether you ar working on a mac or PC. Especially Windows systems need these file endings mandatory, in order to identify the file correctly.

A discussion on the ECI Mailing list also resulted in the following:
The majority of users prefers names containing the capture date.

The following appendixes will be attached optionally as a prefix or suffix:
- Photographer initials (Image portals!)
- Job code
- Variations number
- internal appendixes, that can be entered as IPTC data.

These appendixes are often useful, if the client does not posses an according IPTC-capable software: Highres / Lowres files, 1st / 2nd choice, image source, royalty free / licensed, ...

A naming by motive description was completely declined as not applicable for practical use.
"Client tells the graphic designer – please download the image "blair21.jpg" over at Photopool/ Photoweb/ photofinder ...?
The graphic designer will search for this term and receive 3-6 hits ???

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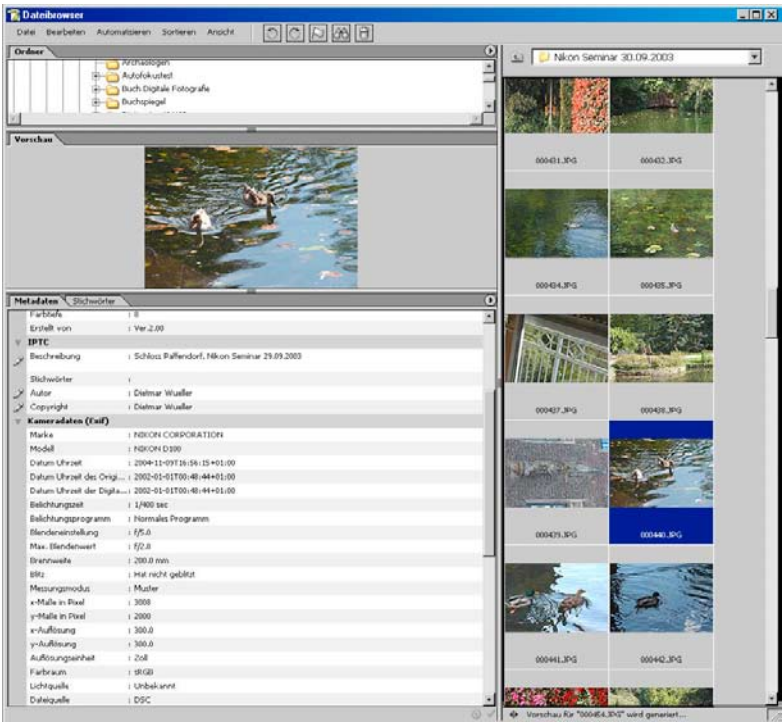
These kind of problems need to be prevented through clearly unique naming of files! (Thanks to Robert Dieth for the abstract)



The Photoshop filebrowser shows EXIF- and IPTC-files and also edits IPTC data.

European Color Initiative
www.eci.org

4 Processing data

4.1 Importing and Processing raw data

While most digital photographers are pretty familiar wit JPEG- and TIFF formats, there is a hidden talent dozing in the cameras used: The possibility to save your images as raw-format.

Digital Negative – Back to the roots

A digital image saved by the camera as a JPEG or TIFF has gone through an extensive editing process by the internal camera electronics.The data delivered by the sensor run through several corrections, e.g. white balance, color, saturation, unsharp masking, if so lossy JPEG compression. As a photographer you only have limited influence on all of these processes (via the camera menu) and you pretty much have to settle with the editing parameters specified by the manufacturer . The influence of these processes specified by the manufacturer on the quality of the result will become obvious whenever cameras from multiple manufacturers use the same CCD, but the results under equal conditions when capturing vary greatly. The raw data format resembles the analogue film, developed and enlarged in your own lab respectively darkroom and therefore meets the requirements for the term "digital Negative". The photographer will obtain the possibility back to switch off the applied automatic processes inside the camera with the aid of the according converters, in order for him to determine himself, how the image is supposed to look.

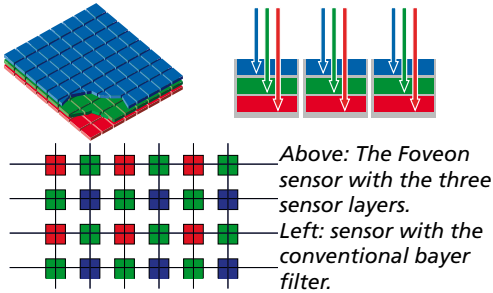
What is raw data

In combination with digital cameras raw refers to a file format by which the cameras saves the information captured by the image sensor, directly 1:1 to the according memory card. In order to achieve the kind of quality that can be produced with this kind of format in an image editing application, a special conversion is required. Due to the specific architecture of the sensor an image will not be digitized the way it is seen on the display or monitor. A special interpretation and optimization of the digital material is necessary. This is also the reason for the term RAW – we are dealing with the raw information coming from the sensor.

Interpolation of color

All "single-shot" digital cameras contain a sensor, which in simplified terms consists of many photosensitive sensors arranged in a grid-like array, that only react to the amount of light falling onto them and which represents an appropriate tonal- / grey value after capturing

/ analysis (the Foveon chip is the only exception). All these tonal values together make the captured image, yet until now it actually consists of greyscales only, that have been captured through a filter, but do not contain any real colors yet. In order to create a digital color image, a filter is applied to each photosensitive image sensor, in one of the three primary colors red, green or blue.



Above: The Foveon sensor with the three sensor layers. Left: sensor with the conventional bayer filter.

In order to simulate the special green-sensitivity of the human eye, the sensors contain 25% of red, 25% of blue and 50% of green filters in a determined array. This determined array is often referred to as "bayer-matrix". In order to receive a fully colored digital image with 100% red, green and blue pixels, the colors have to be interpolated with the aid of very sophisticated algorithms, which are not available for the according pixel due to the bayer-matrix. If necessary the surroundings of e.g. an "non-green" pixels will be taken into account, in order to define the actual color of that particular pixel.

Ingredients to the raw file model

The raw file model consists of three well-defined elements:
Camera data – better known as EXIF data, contains information about the camera used, the applied capture parameters like exposure settings, f-stop, etc.
image parameter – these parameters were set at the time of capture, but can be edited in the raw converter afterwards, which in turn has direct influence on the conversion in the converter respectively on the resulting image. This is about the applied color mode, white balance, saturation, tonal range and application of unsharp masking.
Image data – non interpolated raw data coming directly from the CCD or the CMOS of the camera with high bitdepth (most of the times either 12 or 14-bit).

Advantages of raw data

The advantages of the raw data format when used with the according raw converters, offer a large freedom in the world of digital images in order to achieve the best quality possible. In return the raw data requires a lot more memory than JPEGs and it is rather time consuming to edit them image by image. Thus the raw data format still offers a lot of advantages:
Larger bitdepth that JPEGs or TIFFs: Instead of reducing them to 8-bit

(256 gradations) the tonal values will e saved with the highest possible bitdepth accordingly.
Subsequent infinitely adjustable white balance, independently from the settings inside the camera, usually in the range from 2.000 and 10.000 Kelvin.
Selective contrast of single tonal areas, e.g. via contrast curves wit direct visual feedback on the monitor. If there is an image high in contrast the details in the shadows, with usually little or detail can be lightened with contrast curves, while the brighter parts of the images remain unchanged.
Continuous adjustment of saturation of color in the raw converter in order to control respectively optimize the color nuances inside the image
continuous control of digital unsharp masking, precise adjustments individually adopted to every single image.
No lossy compression as in e.g. the regular JPEG processing

Raw converters

In order to achieve the best possible image quality from the digital camera used, the raw data format should be used. The raw converter is an application, which creates the well known standard TIFF and JPEG files, in order to make the further editing process in all image editing or layout applications possible. All present raw data formats are proprietary. Which is also the reason why there are actually two kinds of raw converters. On the one hand there are the raw converters supplied by the manufacturer, which can convert only their own raw data. Secondly there are the so-called "third party " raw converters which can interpreted and edit the majority of different raw data formats. These groups are separated again into two groups with different strategies for the raw conversion:
linear conversion: raw interpolation, exposure correction and white balance are applied in the application itself; image editing and retouching is done in an extra application.
"Full Service"- conversion: all necessary steps of the conversion and the image editing can be performed in one single application.

The linear conversion is mentioned here actually just for the sake of completeness, since every raw converters has to master this discipline. The result of a linear conversion is a dark image, that needs to undergo a specific tonal range optimization. A detailed description of the complete list of each individual editing step during the conversion would go beyond the scope of this guide. Merely a simple enumeration in note form shall be sufficient enough to judge the functional range of the own converter used:

Comparison of linear to "Full Service" conversion

Bayer matrix interpolation (exception camera raw data from a foveon chip).
Camera specific profiles and tonal range optimization – generic camera profiles for all camera formats supported in order to describe the specific characteristics of the camera.
White balance – stable and neutral grey balance
exposure correction – correction of over- or underexposure
noise removal filter (optional) – the sooner in the workflow the more efficient, in order to prevent a potential amplification in the following steps.
Anti-moirée filter - disadvantage from the bayer matrix and especially important for cameras with a weak anti-aliasing filter
control over brightness, contrast, saturation, global / selective color correction and last but not least "unsharp masking".
Color management – support / implementation of ICC profiles

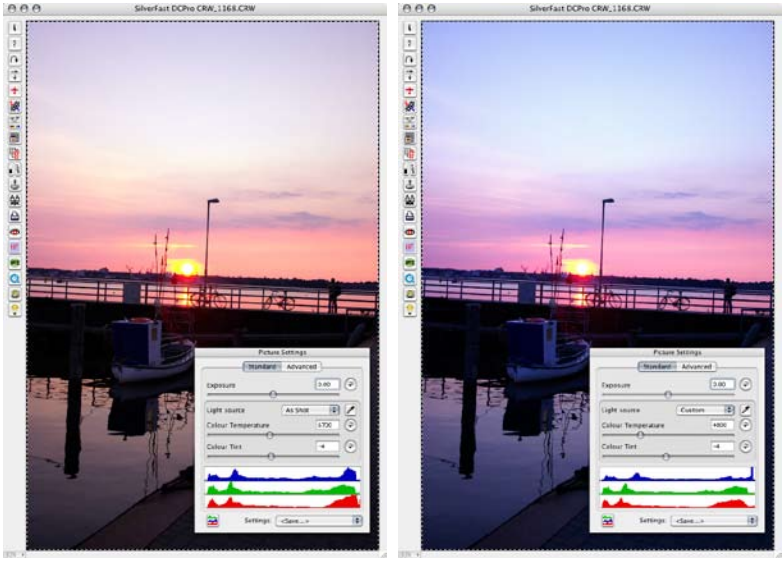
Raw-workflow

After opening a raw file in the raw converter, the user will receive an already interpolated, full color preview from the available "bayer file", that will then be edited interactively with the various tools, dialogues or menu options. With the aid of such familiar and trusted editing tools, like e.g. the gradation curves, the expected results can be associated via live preview to the final result.
With the next steps global corrections like for example USM sharpening filter, moiré- and/or noise reduction will be applied. Finally settings like color space, color depth, output size and resolution will be applied. Only then the actual conversion will be started, while at the same time the primary image data will be interpolated from the bayer-matrix of the raw file, in order to create the digital image in color. This clearly points out the advantages of editing the file in a "raw state", because the full bitdepth available is taken into account as a basis for the computing, opposing a JPEG or TIFF file based on 8-bit, created by the in-camera processing.

Exemplary "high-bit" raw file processing

1.) Choice of the internal working space – in regard to the intended

use
2.) Adjust tonal range – define thresholds for highlights and shadows
3.) Adjust gradation - adjust mid tones, for example using numerical numbers in the histogram or curves like features
4.) Alter white balance – if necessary
5.) Color cast removal – ideally using color temperature (or an according eyedropper tool) as well as a tint / tone slider. An according eyedropper tool can be applied simply by clicking inside the image on neutral grey subject tones. This procedure doesn't always create the expected result, because quite often the light situation while capturing the image wasn't neutral either.
6.) Activate moirée removal
7.) Smoothing and noise removal
8.) Apply unsharpmasking
9.) Choose final color bitdepth
10.) Select output and pixel dimensions – upsampling on the RAW file often gives better results in comparison to already processed files
11.) Continue editing for example retouching or small enhancements in the favorite imaging application



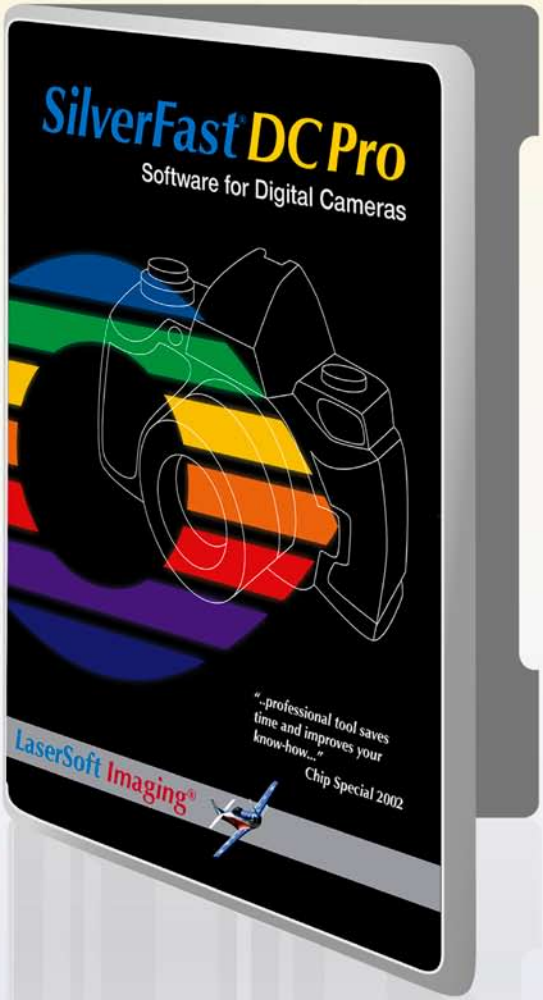
In the left image color temperature and tint were set to remove the alleged color cast; the evening mood was contained but the colors in the sky seem dull and weak.
The right image is more accordingly to the actual scene after a manual white balance optimization.

SilverFast® DCPro

Software for Digital Cameras

supporting RAW data format

RAW
TIFF
JPEG


SilverFast DC Pro
Software for Digital Cameras
"...professional tool saves time and improves your know-how..."
Chip Special 2002
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There are many good reasons to work with RAW files – this one is from SilverFast!

Get RAW with this fully fledged imaging program for OSX and Windows! SilverFast DC Pro is the new serious raw converter and digital camera software from the makers of the award winning SilverFast scansoftware. Look no further if you simply want excellent image quality for your creative production power! It's not just the sheer speed and image control but the real beauty of SilverFast DC Pro lies within the complete set of multimedia tutorials built right into the software. In short DC Pro gives you professional tools with an excellent degree of versatility. See for yourself by downloading a fully functional trial at **www.SilverFast.com**

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4.2 Tonal range levels and gradiation adjustments

Different imaging applications offer different ways to optimize allegedly too dark, too weak or too light images. Please avoid in almost any case the brightness- / contrast slider, since the tonal values will be changed in a rather "crude" way. The settings of histogram or tonal range levels respectively gradation curves are much better suited for this kind of purpose.

Tools for image information

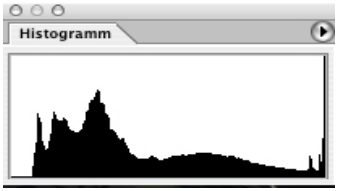
When optimizing images manually it can be mandatory to be able to follow up on the changes applied. Nearly all imaging applications offer either a graphical data display in the shape of an histogram for this kind of purpose or a numerical in the shape of an "info-tool" or densitometer. Using these two tools at the same time enables the display and optimization of data at the same time. Additionally both of these tools make it easier for the user to actually understand the changes applied.

The densitometer

The densitometer / info-tool displays the actual pixel data (actually greyscale values and the related color values of the pixel)of the image in numerical values in two groups. One group displays the measurements before and the second group displays the measurements after the optimization of the according greyscale / color values of the measured image area.
There is one detail that needs to be checked upon which is the radius of the densitometer / info tool. In general it can be set to measure a single or an average of a certain number of pixels, e.g. a 3x3 or 5x5 pixel radius. Normally an average of numerous pixels should rather be read because single pixels could read false values due to noise.

The histogram

A histogram is based on the analysis of all pixels from a single digital image. The distribution and the amount of pixels from different tonal levels are presented graphically. On the left hand side is the zero point at which the darkest (black) pixels are settled, the right end is the origin of the brightest (white) pixels. The width of the peaks and valleys indicates which spectrum of gradations an image contains. The height of an "data peak" indicates how much data this certain part of the greyscale spectrum contains.



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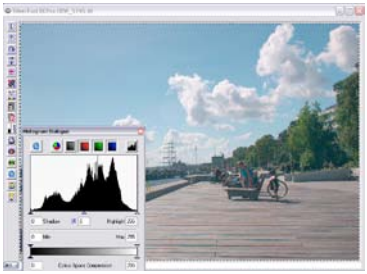
Manual image optimization

This chapter will analyze the manual approach of the usual adjustments and optimizations.

Optimization of tonal range

The optimization of tonal range is a procedure to adjust brightness and contrast. If performed in single color channels, the tonal range optimization is also used for the compensation of color casts.
The quality of an image will be reflected by an either "good" respectively "bad" histogram. A "good" image (see example on the left) normally uses the complete width of the available tonal values. A "bad" image on the other hand (see example on the right) will not use the complete width available or it won't reach to the end of the scale on both sides of the histogram.



Please remember – a graphical histogram display represents the complete range of greyscales. This means, in order to make a "good" histogram from a "bad" histogram, for example a flat image, a correction needs to be performed, which spreads the available pixels over the complete scale of the available tonal values.
An optimization of tonal values thus needs to be performed if the pixels in one channel need to be recomputed because they do not cover the whole available scale of for example 256 tonal values in an 8-bit workflow in order to improve this range. This creates an improved saturation in colors and a higher contrast, which means black will be darker and white even brighter.

Set highlights and shadows

Before setting highlights and shadows, the brightest and darkest spot in the image needs to be searched for and analyzed whether they coincide with the important "content areas" of the image afterwards we can use the histogram dialogue for a manual optimization of high-

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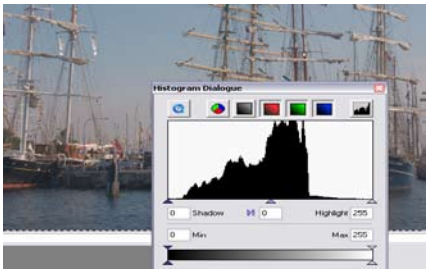
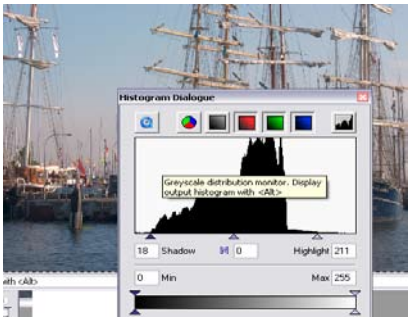
lights and shadows with the great advantage of actually seeing the optimization in a live preview while performing them. The following example is supposed to clarify how to use the histogram in order to adjust the highlights and shadows.

This is a clipping of the image used prior to any optimizations, and as we can see it is desperately asking for some attention because it is simply flat.

The empty left area of the sample histogram indicates that there are no pixels available in this area, representing black. It is essential now to reapply the minimum highlights as well as the maximum shadows completely new.

This is done in most imaging applications by simply dragging the small triangles on end of the highlights and shadows to the just about noteworthy beginning of the important image data.





Additionally the overall brightness of the images gets optimized by dragging or moving the middle triangle, responsible for the mid tone brightness, until the desired result is achieved.

Note:

As a general rule the use of the brightness / contrast menu in order to adjust the brightness should be prevented in any case because it is the only way to preserve the carefully ad-

justed highlights and shadow levels. The gradation curves dialogue is much more appropriate to adjust brightness.

Adjusting gradation

Until now the optimization of tonal values as setting highlights and shadows were displayed.
The gradation curves dialogue is one of the if not the most powerful tool to adjust for image optimization as well as optimization of gradation. By this each input value (current state of a pixel) can be assigned to a continuous output value (specified state).

The curve in the curves dialogue represents the transformation of the distribution of the greyscale values between the original (the original image, lower edge of the gradation square, marked in green) and the target (what you will get, left edge of the gradation square, marked red). Thus the non manipulated shape of an gradation curve actually is no curve as the brightness values of the pixel in an image appear as a straight line in a xy-diagramm with a 45 degree rise. The x-axis refers to the original brightness (input values) of each pixel, the y-axis represents the new and changed output values.
Only a straight "curve" thus represents equal input and output values. The output value of each pixel still represents exactly its input value. When changing the curves the input and output values will differ.

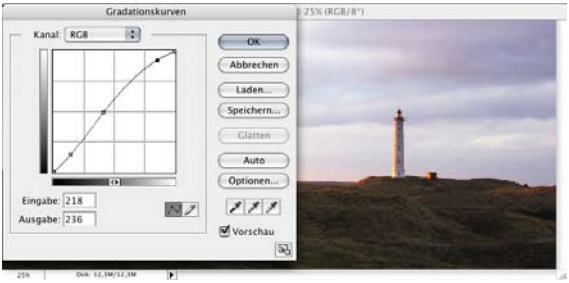
Adjusting brightness

As describe by now a gradation curves dialogue is much more appropriate to adjust the brightness of an image. The input and output can be changed infinitely simply by adding control points to the curve or by dragging the existing points. In order to brighten up an image, without loosing the carefully adjusted values for highlights and shadows, simply change the shape of he curve in the middle tonal values, the so called mid tones, in a way for the curve to bend upwards. By means

of the numerical values we can observe pretty well, how the input- and output values will now differ from each other.

Adjusting contrast

If the overall contrast of an image is adjusted, this will also change the overall shape of the gradation curve.
An s-shaped curve, that is bend upwards in the highlights section and flattened downwards in the shadows section, will increase the overall contrast of an image. A slight increase of overall contrast pays off most with most images, since it will give the image a more photographic look-and-feel.



It may be mentioned to the topics optimizations for tonal values as well as gradation curves.

4.3 Adjusting resolution

Even if the reproduction of fine details - thus the resolution - is in noway related to the number of pixels (= sample rate), the two terms are often equated in practice. Digital cameras provide square pixels in rows and columns. The size of these pixels in the output hereafter is usually not defined during the exposure. Yet the manufacturers do save a so called target resolution in the camera, which is usually at 72 pixels per inch or 300 pixels per inch. By this the pixels are defined by size, which still can be changed later in the subsequent image editing application. The quality of the image will not be changed by the output size of the pixels. In this case the pixel behaves like the film grain. If it remains adequately small or the viewing distance is adequately big, it will not become visible. Only at a certain size the pixel will become visible - like the film grain - and can be recognized as such.
For certain applications the pixel size has to be reduced or in exceptional cases it has to be enlarged. A reduction is necessary if the images will be optimized for monitor or web applications. Also when sending an image via data line it has to be reduced to the required size in order to save time and costs.
Adding pixels will lead to larger files, yet will not generate additional details and therefore should be an exemption (compare 2.3.).

Tip:

For magazines like People or Time images with 4 million pixels (12 mb files at 8-bit) are sufficient for smaller illustrations. For single or double page illustrations files with 18-24 mb will result in a very good quality in the printed result. The bigger files can be compressed via JPEG-format as well (quality level 8 or higher). These images will become approximately 1 mb files, which will not cause any problems anymore in times with fast internet or DSL connections.
Images for web pages do not need to be any bigger than 1024 x 768 pixels and should be saved as sRGB images as JPEG-format.

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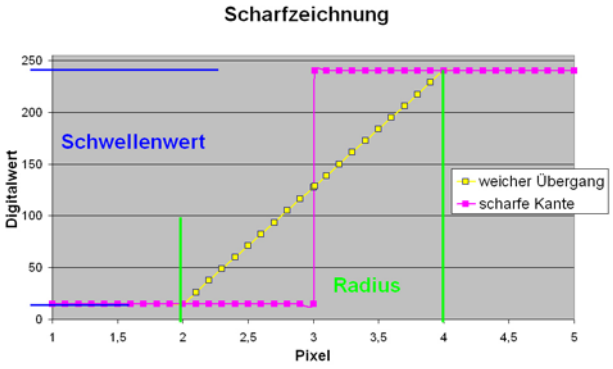
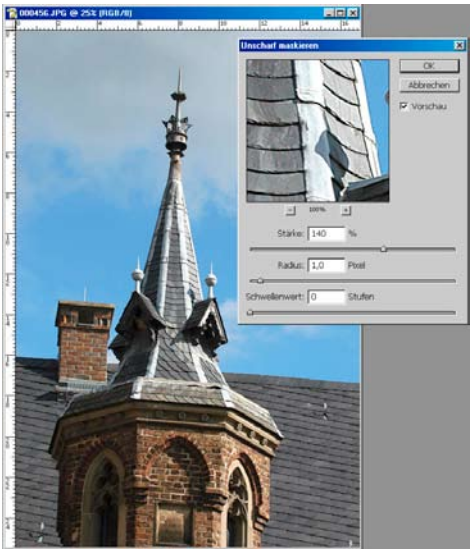
4.4 Additional sharpening

Since different output processes require different degrees of subsequent sharpening and the interpolation to a larger as well as to a smaller file size has a negative effect on the sharpness, it is recommended to perform the final sharpening just before outputting the image.
An out-of-focus image can not be converted into a sharp image with the help of sharpening. But a reasonably sharp image will appear a lot sharper for the human eye by increasing the edge-contrast.

The only adjustable sharpening filter in Photoshop is "Unsharp masking". The algorithm behind is actually a couple of years old and an adaption to newer technologies could be useful. Applications like SilverFast or Nik Sharpener are significantly better in this aspect.
But the algorithm of the photoshop filter is appropriate enough to display the functionality of a sharpening filter. The sharpest edge in a digital image is a black pixel next to a white pixel (magenta line). The softest edge is a brightness gradient across numerous pixels (yellow line).
By adjusting the strength of the filter we can define how vastly the yellow line will be transferred into the magenta line. The threshold specifies how far apart the luminance values have to be, in order to be included by the filter. With a low threshold even the fine differences like noise will be sharpened. This is not the case with a bigger threshold. Common values for a threshold are usually between 0 and 15. For a technical photograph the optimum is tending rather towards 0 and it is significantly higher with portraits, in order not to emphasize skin impurity even more. The preview in photoshop visualizes the result. The radius specifies how many pixels the filter will affect. It can be noticed that if the optimum value is above 2 pixels, the basic sharp-

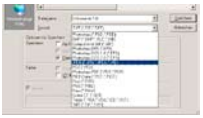


ness of the image is not sufficient enough, in order to receive a really good result. An adjustable blocking of darker areas in the image or single colors, like for example skin tones would be desirable. Also some sort of intermittent control for the "cross conversion" on the edges would really improve the filter. This "cross-conversion" appears if the sharpening was overdone and will become visible through white and black fringing on the edges.



5. Interchange format for the transfer of data

5.1 Recommended file formats



Numerous file formats have been established with digital photography and each one has been optimized for a special assignment. One needs to ponder about the intended use or further processing steps are planned when saving an image. Some formats are recommended for the use in the internet but are rather inapplicable when transferring data to a service provider and the communication with professional prepress.

JPEG

JPEG images have achieved acceptance in digital imaging in those areas in which small file sizes are essential despite photorealistic illustration. It is one of the most important file formats for digital cameras and will also be applied whenever electronic images have to be transferred via internet, ISDN or UMTS (details about JPEG compression under "2.2 file formats / compression / color depth)
The JPEG-format offers some specialities: It can apply the important cmyk color space used for prepress, which is necessary for the professional optimization of images and the output on a rotary printing press. Furthermore profiles for color management can be attached to a JPEG file. Important: IPTC-data can be integrated into the file. Image agencies and editorials manage their photos according to this archiving standard, which contain e.g. the name of the photographer and further keywords (see 3.2).

"Progressive JPEG" is recommended for the internet. Thereby a complete but low resolution version of the photograph will be displayed first . Subsequently the rest of the image will be loaded bit by bit. Another version of JPEG is "JPEG 2000", that operates with a different compression algorithm. The most important imaging applications since are able to read (and write) it, but is has not prevailed yet.
very appropriate for digital cameras thanks to a strong compression
numerous exchange opportunities between different computers

TIFF

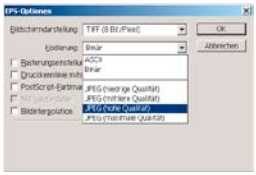
Next to JPEG this format is the most important format for image editors. Tiff-files can be coded in 8- or 16-bit (see "file formats / compression / color depth") and thus it can manage not only 16,8 million colors yet a couple billion color nuances. This image format is supported by all major imaging and layout applications. Normally it operates

without image compression, but if offers the opportunity to downsize the file via LZW-compression. Tiffs can contain either RGB, CMYK or LAB data. By this they cover the most important color spaces / -models within photography and professional post processing. Additionally color profiles can be integrated into the TIFF file. And just like JPEG IPTC data can be integrated into the TIFF file in order to save copyright information. TIFF file can contain alpha channels and mapping paths to save transparent elements in the image and additionally they can consist of multiple image layers.

-save images data without compression
essential color models, color profiles and alpha channels can be integrated

EPS

EPS was originally developed for displaying vector graphics (logos etc.) and basically consists of a "data container" encapsulated in a postscript file. Which is why it was named "Encapsulated Postscript". But the EPS-file can also contain pixel data – thus photos – whereas the image data can also be presented as a space saving JPEG image. EPS files can be saved either as RGB- or as CMYK data. Single elements of the image can be saved as a mapping path, in order to place the photo in front of a different colored background or in order to align text around the outline. The EPS file can contain a low resolution preview of the photo, which is why it is preferably used in a layout applications. During the layout stage the application accesses just that and used the highres data just prior to the output. The behavior of EPS files is problematic in relation to color management. With a trick ICC profiles can be attached to the file by photoshop while editing the image but generally these won't be accepted by the layout application and therefore the color in the final print will be a game of luck.



saving without compression possible
different color modes will be checked
integration into layout applications (mapping path etc.)
problematic in ICC workflow

PSD

PSD is the photoshop native file format. It can save images in RGB and CMYK as well as other color models, furthermore the unique layers of an image will be preserved. It is less adequate for the file transfer because the recipient implicitly has to open the files with photoshop.

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There are other applications that understand this format, but there may occur problems due to incompatibility. This is also true when exchanging between different versions of photoshop.

ideal working format within photoshop
many color models possible, individual layers for composings will remain in the files
less appropriate for file transfer

RAW

The RAW format is not appropriate for exchanging files either. Since RAW images are almost always saved in a special proprietary format by the manufacturer, the recipient of the images will need to have the according software, in order to open this format (see also "Photography – file formats / color depth / compression").
Raw does offer the advantage that image data can be saved 1:1 from the CCD, in order to retain extensive possibilities for optimization. More and more professional photographers use this format, yet in order to transfer the images it has to be converted into one of the common standard file formats.
high quality premium alternative to save images in the camera
has to be converted to a standard format with special software when exchanging files

GIF

GIF is a graphics format developed for the internet by the online service provider CompuServe. The "graphics interchange format" is able to display 256 colors only and thus can be used to display graphics (logos, buttons, etc.) with defined spot colors and a strong image compression. Which is why it was established as standard for graphics on the internet. Inversion GIF89a it can save multiple images within a single file, that can be played as an animation.
displaying logos and graphics (buttons, background graphics etc.) on the internet
animation on the internet

PNG

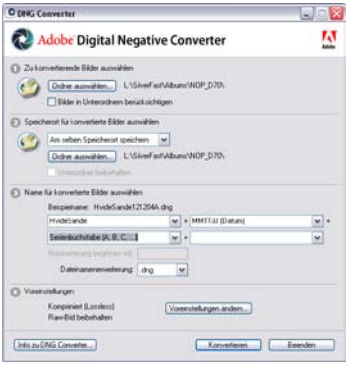
The PNG (pronounced "ping") was developed in order to by-pass the disadvantages of the GIF format. The "portable network graphic" format can display up to 16,8 million colors. Even though all modern internet browsers can read PNG and the World Wide Web Consortium W3C formally recommends it, it has not yet been enforced completely. PNG compresses the images with a lossless algorithm and can contain one transparency channel.
• images with transparencies for the internet and multimedia applica-

tions
• minor distribution

GIF and PNG have almost no meaning in the area of digital photography.

DNG

Adobe Systems has done an innovative step, which has heated many discussions since. The innovation consisted of giving the users and manufacturers a unified file format for RAW data to hand. On the first impression this does not seem to innovative yet it is no reality in digital photography, because until today almost every manufacturer of digital cameras saves it`s own RAW format. For the data to remain processable, the manufacturers offer their own converters to each appropriate format. Yet since with each introduction of a new model a new RAW format is introduced, it is possible for older formats not to be supported anymore in 4-8 years by the according tools or other third-party converters.
DNG offers a unified RAW format as an open standard, in which a large bandwidth of camera models can save all necessary image information into a unified file format. A future-proof solution for archiving images in DNG format is possible with the also freely available DNG converter by Adobe Systems. The DNG-converters at the time supports all RAW formats by the common camera models. The initiators emphasize that by using the DNG-format it is guaranteed that a once archived RAW file can be opened and processed even in 10 or more years. Whether the DNG format will become accepted as standard (thus can still be opened by Photoshop in 10 years or more) strongly depends on when and how the camera manufacturers will start supporting this file format. At the moment many users and potential clients are still waiting for the first manufacturer to offer native support for the DNG format.
Note:
If the DNG conversion is supposed to be used for archiving in RAW format, the option to preserve the raw file should be chosen. By this the image data will be saved in its original "mosaic format" (see 4.1 – What are RAW files). If improved methods for conversion should become available in a couple of years, these could be applied to the archived RAW files. In return these could not be applied to an already linear converted file anymore.



Open DNG files in Adobe Photoshop CS:
For opening and displaying DNG-files in Photoshop CS you will need the latest Camera Raw 2.3 plug-in. You will receive access to the latest version via the downloads section on www.adobe.com.

PDF/X3

Early september 2002 the ISO-standard 15930-3:2002 – better known as PDF/X3 – was published. PDF/X3 is a standard in the shape of a file format. It is based on the PDF-format and describes a standardization for the transfer of digital lithographs. PDF/X 3 constitutes the concept of media neutral (device independent) storage and transfer of digital originals for print (e.g. Offset- or newspaper print), yet accompanied with an explicit description, for which output process the file has been created and optimized for.
The strong focus on process control is actually intentional and because of it so essential, because all participating parties will benefit from the high level of security:
the creator of the digital lithographs (graphic-, designer or more often the photographer themselves) will be granted security that the files delivered were transferred correct content-wise as well as colorwise to post-processing.
The service provider (e.g. printing plant, newspaper publisher) can assume with safety, that the digital originals provided to him will run smoothly through his internal processes without mistakes. In addition to that he will be able to achieve (or even exceed (the expected results) with the originals provided.

In order to provide method for the creation and processing of PDF/X3 to the rookie in particular, two "cooking recipes" were created by the ECI working group PDF/X3, these explain the important steps in all major DTP-applications. These "cooking recipes" can be downloaded in the download section of http://www.eci.org .
While part 1 describes the creation of process-optimized data with QuarkXpress as layout application, part 2 shows how-to create media neutral PDF/X3 files when applying InDesign 2.

Links

www.jpeg.org/
http://en.wikipedia.org/wiki/Encapsulated_Postscripthttp://www.eci.org/eci/en/032_pdfx3.php
http://www.pdfxreport.com/faq.html
http://www.pdfx3.org/

5.2 Communication transfer

In order for large amounts of data to be delivered safely to the editorial staff the postal service makes sense. Burned on a CD-ROM the images are saved cost-effective and in large amounts, and if the CD is packaged correctly, the images will not take harm. Yet short-term delivery deadlines and speedy corrections often demand for a faster more flexible solution. This is where the internet comes into play, while the transfer rate sets limits though.

Email attachments

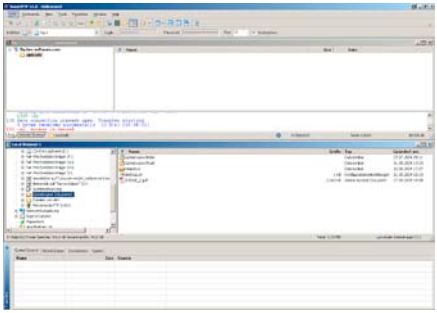
Email transfer is one of the most important alternatives for file transfer. Any number of files can be attached to an Email as an Attachment in order to be sent to the recipient. The transfer of images with rather big files is only recommended though if both parties have at least fast DSL access. Otherwise the transfer will too long. Many mail provider also limit the permitted size of attachments which may also block the transfer. For this reason it is recommended to attach the individual files to single mails and send off separately. Due to the size-limitations the JPEG file format prevailed. Layouts though will be sent as low resolution PDF-attachments to the Email.
The speed of the file transfer is dependent on the internet connection of the sender as well as the recipient: a DSL connection operates with standard 128 kilobit/s upload- and 768 kilobit/s download speed, modern solutions allow even higher transfer speeds of 384 kilobit/s upload and 3.072 kilobit/s download (as of august 2004).

ISDN

The file transfer via ISDN-connection has been established as standard for professional prepress. Since Apple Macintoshs are often used in this area, many editorial and printing plants are relying on Leonardo-ISDN cards from Hermstedt, which have become a de facto standard. On the PC side the Fritz-cards from AVM are used more often. In both cases the hardware in combination with the provided software takes care of establishing a connection, the communication and transfer to the recipient. While the differences between the different operating systems actually play major role, yet are no insuperable barrier anymore. You simply enter the phone number of the ISDN-remote station on the graphical interface and subsequent-

ly choose the folder to be transferred. The native Hermstedt protocol for file transfer plays a major part when a communication between two ISDN-cards is applied, with Fritz cards on the PC side the Euro-file-Transfer protocol is applied in most cases.
The transfer speed is 64 kilobit/s per ISDN-channel. Often times the used software / hardware solutions offer two ISDN channels for file transfer, so 128 kilobit/s can be achieved. There are solutions available in order to connect a number of ISDN-cards to an array in order to achieve even higher transfer rates. The connection of more than one of ISDN-channel will create significantly higher costs though for transferring files.

FTP



The fast File Transfer Protocol has proven itself for the direct Internet file transfer without E-mail. The sender requires access to an Ftp-server, to which he will save the digital images and text. In order to gain access to the FTP-server he requires some details: The target has to bee addresses by an IP-address or URL, thus a numerical order like 192.168.150.90 or ftp://ftp.provider.com. If it is a non-public server a username and password is required additionally. The only disadvantage is that it is not possible to address the recipient directly or a search like in a database is not possible, yet the images reside the images reside on the ftp-server organized in a file directory. In terms of speed the same details are true as for E-mails.

Website and database

If images, pdf files or other data are supposed to be organized or presented with a preview, then one has to arrange a website. Similar to the pure FTP-server the images will be provided to a webserver. A link on a html-page will refer to it, from which it can be downloaded. The Hypertext Transfer Protocol (http) will regulate the data stream. HTTP was originally designed for websites, yet in the meantime it regulates the transfer of any kind of data.
More professional solutions are structured databases, which can be searched systematically. One of the most popular database systems is for example mySQL, which receives a graphical interface with the script language php. Those kind of collections available online allow for a comfortable search, yet have to be organized constantly by the user. In terms of speed the same details are true as for E-mails.

Direct connection via modem

The direct communication between two modems is actually very rarely by now. The modem will dial the number from the other person, that will accept the call. Then by entering commands like "upload" or "download" to the command line console files are sent or received from the download-area. The detour via a provider is unnecessary herewith, since the transfer takes place directly between the sender or recipient without the intermediary. Standard modems, often times already built into PCC or Laptops, will achieve file transfer rates of up to 56 kilobit/s.

UMTS

Ever since the introduction of the Multimedia Message System images or similar can be send from a mobile phone as well. Even in distant areas data can be transferred – provided that the device used supports the standard.
The weak point so far is transfer speed. The present standard GSM sends a maximum of 384 k/bits on 8 channels only if the mobile phone provider supports special techniques like Enhanced Global Rates for Global Evolution (EDGE). UMTS is under development in germany at the moment, which will support adequate transfer speed s of 2 Megabit per second by default. In case the recipient will have less bandwidth available there will be no problem since the files are commonly saved on the internet. The receiver will informed about a link, under which the material can be found.

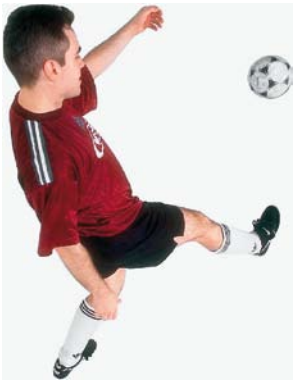
6. Application specific considerations

6.1 Photojournalism

The photojournalism has experienced some significant changes through digital photography which are of technical as well as of content nature. The production workflow was shortened significantly through the use of digital cameras which consequently leads to the fact that images can be inserted into the layout faster and even at a later point of time. Sport events are a popular example for this: It is digital photography and the possibility to send the images directly to the editor via mobile phone or Internet / UMTS that enables newspapers to publish the results from a late evening event in the newspaper next morning. The accompanying advantages were the reason for digital cameras to be used almost exclusively in day-to-day journalism. And thanks to the high-resolution SLR cameras used even large format image sequences for magazines can be realized without a problem. Images in the area of "portraits" or "editorial" are produced with digital solutions as well most of the times.

Flexibility while shooting

For the comparably low resolution newspaper print image data has been sufficient enough for a long time now. Hereby digital cameras produce data, that needs to be reduced artificially by the photographer, in order for the photo to be transferred to the editor as a digital file subsequently. Even for large-format magazines that feature high screen rulings printed on premium high-quality papers there are no more limitations left. SLR cameras with up to 14 megapixels (as of August 2004) will provide a file size for example that can easily realize a DIN A3 page.



Transportable solutions for medium- or large-format cameras with sensors and up to 22 megapixel resolution make even larger image formats possible, if used in multishot-mode. These will simply move the CCD-sensors slightly between the single exposures and create huge files, that are used mainly for advertising- or packshot photography.

Serial images and zooms

Speed has increased extremely with digital cameras as well. Digital SLRs with serial shots of more than 8 images per second and 40 images in a row are available, whereupon those images are still available in the maximum resolution offered by the camera.

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The so called focal length multiplier is evenly important, which is caused by the limitations of the cropped field of view caused by the smaller film frame area in comparison to the 35mm format. It actually amplifies the tele effect of the lens by factor 1,5 or even 1,6, which is why photographers in the field of sport journalism can revert to extremely powerful solutions., that have not been available so far with analogue technology. The sRGB-settings of the camera used is recommended as standard, if custom profiles can not be created for the camera. The agencies and editorials are accustomed to this color space and will process the images according to the parameters from their own printing facility. Applying other color spaces when transferring the files will need to be discussed in advance with the service provider.

File transfer and communication

The file transfer will occur either via Internet or by mobile phone, whereupon the UMTS technology has not distributed well , yet thanks to higher bandwidth will gain significance quickly. The images will be saved and transmitted as JPEGs almost exclusively, because this file format can achieve a rather good image quality with relatively small file sizes. It will be up to the photographer whether he will save the images in this compressed format right away or shoot in raw mode first. These will need to be converted into a standard format like Tiff or JPEG with a special piece of software that came with the camera and a laptop computer.

Image management and accounting

IPTC-information will be embedded into the images, which will be integrated into the files via a special imaging application or special software. It contains information about the capture date, photographers name, keywords for indexing and similar data.
The image agencies will administrate these images according to the IPTC-informations in the image databases and content management systems, thus they can selectively search images to a certain topic. Additionally the IPTC-data simplifies the royalty billing between the agencies, editorials and the photographer (see also chapter "5.1 Interchange format for the transfer of data").

Tempting and dangerous

With the emerge of digital cameras a certain problem in photo-jour-

nalism was amplified, which did exist before, yet received a growing role with the potential of digital image editing – image manipulation. Any part of a digital image can be manipulated by applications like photoshop or other imaging applications.
Anything that could be accomplished in the analogue lab, yet required significant background knowledge, great technical skills and a lot of time, has now become very simple with the computer which is why almost anybody can accomplish these kind of image manipulations.

Proposed solutions for image manipulation

Attempts by journalists organizations, to explicitly label a manipulated image in the printed version in order to be displaced from the authentic image, have not yet been achieved successfully.
Part of the problem consists of the fact that the grey zone between a technical optimization and the manipulation in form and content is rather large. The same tools that can be used in an imaging application to remove dust from an digital image, can be used in order to remove a person from an image as well. The manipulation itself doesn't have to be extensive. Even subtile corrections, like changing the color of an image, can lead to a completely different message of the image content wise.
The reader of a newspaper or magazine, who sees a printed image, thus needs to know that the image does not reflect reality. Even the postcard idyll of the hotel booked upon the travel brochure can be deceiting – because construction cranes or power poles in the background are removed from the image within seconds. Many people are actually aware of this fact but they will suppress it subconsciously and have accepted it for images used in advertising.
The photojournalist – and the editorial staff too of course – carry an extended responsibility with digital photography.

A simple and far from perfect retouching in an image editing application with the "clone tool". The windmill is erased from the photo within seconds. Certainly this can be performed just as good on unwanted persons.

6.2 Portraiture photography

Quite often the photographer enjoys more liberties in portrait- than in product photography, since he needs to pay less attention to the exact reproduction. The exact reproduction of color is the most important factor when photographing products for a catalogue, the portrait photographers client expects to be pictured as flattering as possible. Instead of precise and neutral color reproduction, which most people would regard as too pale faced, rather saturated skin tones are expected.
But as soon as one starts shooting for magazines, the same guidelines apply, as described in the chapter about "advertorial photography". It has to be clearly secured that all output devices in the workflow are calibrated and secured by embedded color profiles.
Additionally the relevant color space plays a major role in this area too. For example when scanning and converting an image to sRGB working space, highly saturated colors will appear rather flat in comparison to larger working spaces like AdobeRGB or ECI RGB. If the digital image will be transferred to an exposure unit, sRGB should be chosen as working space, just in case the service provider does not apply proper color management. Yet for the reproduction in a offset printing process it has to be separated to CMYK.

The left image is shown in sRGB colorspace, AdobeRGB was used as color space on the right image.

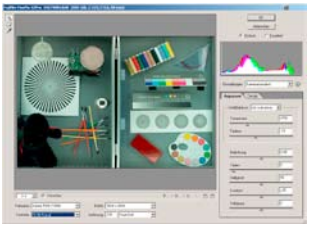
Equipment

A good portrait is more than just a comprehensive face. It is supposed to display the character of a person, the environment or the achievements. So besides the passport photograph in the studio. a portrait is created around nature with transportable photo equipment or around someones working environment. Next to the camera further equipment makes sense. For example a transportable computer provides plenty of storage in order to transfer the files quickly via firewire cable. Alternatively the images can be saved from the memory card to a convenient ImageTank. Those are transportable memory card readers with a built-in harddrive, which can save a multiple of the memory card.

Post processing

If color gradients will get torn up during post processing due to large steps in tonal range, the limits of digital post production will be dis-

played. The 256 shades of an 8-bit will be pushed to their limits especially in the area of large format. That is why a photographer will prefer raw files in the according proprietary raw-format. Even though not all bits of the available 16-bits color depth are used, the data describes better tonal values, however they have to be edited digitally, because it is lacking white balance for example (see 4.1).



Photos in Rawformat - or with a 16-bit colordepth - contain significantly more shades of color than standard 8-bit JPEGs.

The digital alternatives to the classic screw-in filters can also be applied to this raw material, without limiting the available nuances too much: fog- and star filters, black- and white conversion or soft-focus. The screenshot for example display the classic fog-filter from Nik Color FX, that creates a diffuse environment.

The digital retouching is anticipated by the customer's requirements. In this case the digital tools help to create a favorable digital image. By this smaller skin impurities can be removed with the clone-tool, wrinkles are removed with the soft-focus tool and a healthy tint is created with the help of adjusting levels.

Links:

www.photoshopforphotographers.com/pscs/download/PSCS_colmanage.pdf

6.3 Advertising photography

Advertising photography involves product-, fashion- and industrial photography as well as architectural photography. There is only one limitation to it: the image statement and the composition have to comply with the advertising concept of the client.
Problems will occur as soon as the images have to proceed through individual production steps until the final catalogue- or newspaper print. The applied devices each have their own color space (like RGB o CMYK) and subsequently have an appropriate color profile. The color reproduction is massively influenced by this. Additionally some devices are able to reproduce only a comparably small portion of the original color space. Yet in a catalogue it has to be guaranteed that a product will be printed realistically on paper. Therefore all parties in the production process have to comply with exact standards.

Workflow in the Studio

The equipment of a advertising photographer covers a digital SLR as well medium format cameras with digital backs as far as large format cameras, which can be used not only in the studio but thanks to laptop computer for architectural photography too. The printable results are the technical benchmarks. The camera not only has to deliver a high resolution but also has run clear of other optical aberrations. Requirements in regards to image resolution are defined by the customer. For example 11 megapixel are expected in advertising photography these days, Yet higher resolutions are not really a problem anymore for todays digital backs as well as D-SLRs.

The complete range of devices in the studio have to comply with comprehensible guidelines, in order to receive the expected results back from the printer.

The key parameters will be defined during exposure:
1.) the color temperature of the studio lights has to be aligned accordingly because otherwise there is no way to control different light sources with different color temperature. The aftereffect: A colored gradient on a face or a nonuniform illumination of a surface. This kind of fine-tuning is not only important for the design of the image but also a question of efficiency. Constant results can be achieved on different shooting days. Work gets done faster because the different devices don't have to be readjusted.
2.) The cameras color space defines the mixtures of the palette, how many colors can be reproduced and whether they can be converted flawlessly to a different color space. Normally the photographer has two of them available during exposure: sRGB or AdobeRGB. In addition there are the proprietary

raw formats. As rule of thumb the working space used by the camera shouldn't be changed without urgent cause. With one exemption which is if a camera specific color profile is available in order to convert the image to another device independent color space.
The very limited nuances of an image shot in sRGB will not be multiplied through conversion anyways. Indeed we could assume that such a comprehensive color space like CIE-LAB would universally deliver the best possible results. However the 256 tonal shades also create an obstacle: the bigger the color space is, the bigger the offset between them. The consequence is, that the reduced color gradients from sRGB will appear streaky. Adobe and ECI are much more adequate for this purpose. But difficulties may occur here too, due to software- and camera related problems, if one can not reach that color space coming from an individual camera profile. This also occurs in the area of compact digital cameras with the even smaller sRGB color space.
3.) All devices, camera, Monitor or printer have to be calibrated. This is the only way to accomplish a correct match in the studio and on the reference print (proof), which anticipates the final result from the printer. The photographer has to be able to comprehend the complete steps on this way. In order to keep this process steady device dependent profiles will be used. As so called ICC-profiles they are compliant to the standards of the International Color Consortium. But one should not trust these profiles eyeless. Instead they have to be double checked either by yourself or a qualified service provider.
For example a camera can be calibrated by shooting a test chart in the studio, a software like the Gretag Macbeth Profile Maker Pro (www.gretagmacbeth.com) or the GMG CamFlow (www.gmgcolor.com) will analyze it.
The next output device, the monitor, will be measured by a spectral photometer and the appropriate profile will be created by a software. Complete packages, consisting of a measuring device and a software, are offered by e.g. Gretag MacBeth, BasICColor or X-rite.
The final print of a premium proof as a reference requires even more accuracy. For example the whitepoint of the paper doesn't always comply with the requirements of the ICC-profile of the printer. Therefore special proof paper should be used.
With the help of a common, non-profiled inkjet printer, one will not get too far. A profile and the appropriate paper some inkjet printer will deliver a rather good simulation. Yet when printing from layout applications the use of a RIP software, that supports color management, is recommended. Here we can take the applications from ColorGate, Efi or GMG as an example.
These arrangements can adjust an inkjet printer with the appropriate settings in order for it to simulate the offset printing process and

which, if it follows the ISO norm for offset (ISO 12647), is described by the ICC-profile of the Mediastandard print. These are available for download from the ECI website and should be embedded into the image file when transferred to the printer.
As far as Monitor and printer are aligned with each other, a soft-proof can be simulated on the monitor and subsequently a real proof as reference for the printer will be created.
A control strip for the Mediastandard print, the FOGRA mediawedge from the "Forschungsgesellschaft Druck" (www.fogra.org), will be printed along, which will eventually get analyzed on the compliance of the tolerances with a spectral photometer and the provided reference data. In order to compare these prints visually, D50 normlight is mandatory.

Pack in a box for digital transfer

If the digital data is accompanied by a proof, either the CMYK-version that was used for the proof print should be transferred along with the RGB-version of the image, or the image should be saved as PDF-X3 and delivered with a so called "output intention" (see 5.1). If a packshot is supposed to be printed without background, the mapping path is usually embedded. With the help of the path tool in photoshop contours will be saved as a constant selection. In this case the Encapsulated Postscript format (EPS) is recommended. Those mapping path can be embedded in Tiff files also. Frankly not all output devices will recognize and thus they often lead to problems.

Archival

Generally speaking the original unedited material should be saved, even if a correction seems necessary. It contains the original EXIF-information which will eventually get lost during further editing. In any case an image should contain the IPTC-data, whether it will be archived or transferred to the editor. The entries comply with a database standard, which is valid in most professional image agencies. All major powerful Image management software is able to readout these informations. Additionally an edited RGB version can be saved. One will spare the repeated color corrections or the creation of complicated gradation curves.

Links

www.color.org/

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